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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N91-12514# National Aerospace Lab., Tokyo (Japan).
PROCEEDINGS OF THE 7TH NAL SYMPOSIUM ON AIRCRAFT COMPUTATIONAL AERODYNAMICS
1989 303 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 29-30 Jun. 1989
(NAL-SP-10; ISSN-0289-260X) Avail: NTIS HC/MF A14

Various topics in computational fluid dynamics are discussed. Hydrodynamics of atmospheric phenomena, turbulence models, separated flow around a wing, transonic flow over a wing, shock wave propagation, scramjet flow computation, heat transfer in a curved pipe, and numerical simulation of supersonic inlets are among the topics covered. For individual titles, see N91-12515 through N91-12562.

N91-12515# National Aerospace Lab., Tokyo (Japan).
SIMULATION OF A PARALLEL COMPUTER WITH A 2-DIMENSIONAL CFD PROGRAM **c62**
Koichi Harada, Masahiro Yosida, and Kinuyo Nakamura *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 13-17 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A simulation program for a parallel computer configured with 128 x 256 processing elements and the assembly language were implemented on the Numerical Simulator in the National Aerospace Laboratory. The former simulates the memory access and register operation at the clock level and generates time diagrams along with operation results; the latter describes the procedures for the parallel computer. The parallel processing time of 128 x 256 processing elements is compared with the sequential processing time of the uni-processing element, and an evaluating method for the parallel computer with a 2-dimensional computational fluid dynamics program is described. Author

N91-12516# Nippon Electric Co. Ltd., Yokohama (Japan). C/C Information Technology Research Labs.
A TWO- AND THREE-DIMENSIONAL FLUID FLOW ANALYSIS SYSTEM USING A FAST LINEAR SYSTEM SOLVER **c34**
Yukinori Akiba, Shun Doi, Ken Hayami, and Seiji Ishihara (Nippon Electric Co. Ltd., Tokyo, Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 19-25 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Researchers propose a preconditioned conjugate gradient type method suited to supercomputers for solving large sparse nonsymmetric linear systems arising in finite difference fluid flow analysis which employ boundary-fitted coordinates. In two-dimensional analysis, by using only the 5-point finite difference matrix as the preconditioner, the linear systems can be solved efficiently by the Tridiagonal Factorization conjugate gradient square (CGS) algorithm, which can be easily vectorized. The method is also applicable to three-dimensional problems by using the 7-point finite difference matrix as the preconditioner. These techniques are employed to realize a fast 3-D fluid flow simulation system. Numerical experiments were done on the NEC SX-2 supercomputer. Results show that the Tridiagonal Factorization CGS (TFCGS) algorithm is 1.3 times faster than the conventional incomplete lower-upper CGS method. By using the 7-point TFCGS method, a very high vector ratio of 99.9 percent is achieved, and the computation speed of the vector mode is 53 times as fast as that of the scalar mode. Author

N91-12517# Kyushu Univ., Fukuoka (Japan). Dept. of Aeronautical Engineering.
NUMERICAL CALCULATIONS OF SEPARATED FLOWS AROUND A WING SECTION AT UNSTEADY MOTION BY A DISCRETE VORTEX METHOD **c02**
Shigeru Aso, Atsushi Fujimoto, Naoki Futatsudera, and Masanori Hayashi (Nippon Inst. of Tech., Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 27-32 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Separated flows around a wing section at unsteady motion are simulated numerically by a discrete vortex method combined with a panel method. The potential flows around wing sections are expressed by vortex sheets, and separated shear layers are expressed by discrete vortices. In the calculation, a separation point is determined by solving the boundary layer equation. The strength of shed vortex is estimated using local velocity near separation point. Also, modifications for the estimation of pressure coefficients around wing section are proposed. The estimated pressure distributions show good agreements with experimental results. At first, calculations are carried out for a wing section at fixed angle of attack. The results show excellent agreements with experiments. Secondly, separated flows around pitching airfoils are simulated. A hysteris of the lift of an airfoil at dynamic stall is obtained in the calculation. Those results suggest that the present method is quite useful to simulate separated flows around a wing section both at steady and unsteady motions. Author

N91-12518# Institute of Computational Fluid Dynamics, Tokyo (Japan).
UNSTEADY CALCULATION OF THE TRANSONIC FLOW OVER ONERA-M6 WING WITH A SIDE WALL **c02**
Takuya Sakuragi and Keisuke Kamo (Fuji Heavy Industries Ltd., Utsunomiya, Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 33-37 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

The major portion of the flow field at high Reynolds number will be unsteady, so turbulent eddy viscosity models are used in simulating such high Reynolds number flow. The steady flow fields obtained by using the turbulent eddy viscosity model is expected to be the time-averaged solutions. In this study, researchers investigated the unsteady solution of the flow over the wing with a side wall. For this purpose, they calculated the time-average of the unsteady flow field without using any turbulent eddy viscosity models. As the number of grid points gets large, the CP curves of the time-average will become close to the results of the experiment. Author

N91-12519# National Aerospace Lab., Tokyo (Japan).
TURBULENCE MODELS FOR TRANSONIC FLOWS WITH SEPARATION **c02**
Yoko Takakura, Satoru Ogawa, and Tomiko Ishiguro *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 39-44 In JAPANESE; ENGLISH summary Prepared in cooperation with Fujitsu Ltd., Tokyo, Japan (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Computation of 3-D transonic viscous flows around the ONERA-M6 wing is performed by using several turbulence models with an improved Harten-Yee Total Variation Diminishing (TVD) scheme. The models used here are the Baldwin-Lomax model, Subgrid-Scale (SGS) model and Jones-Launder (k-epsilon)-model, and the test condition is a flow with the interaction of shock wave and boundary layer under the large separation. As the result, it is concluded that the SGS and (k-epsilon) models work well compared with the Baldwin-Lomax model, and that the physical phenomena such as the interaction of shock wave and boundary layer numerically captured are qualitatively correct when the pressure distributions agree with experimental ones. Author

N91-12520# National Aerospace Lab., Tokyo (Japan).
AN ASSESSMENT OF TURBULENCE MODELS IN COMPRESSIBLE VISCOUS FLOW ANALYSIS **c34**
Yuichi Matsuo (Tokyo Univ., Japan) and Shigeru Saito *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 45-51 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Recent advances in computational fluid dynamics in conjunction with both higher computer speed and a more efficient numerical algorithm have made possible viscous computations of complicated flow fields. However, the accuracy of the prediction depends to a large extent upon the turbulence model used and deteriorates as the shock wave becomes stronger and eventually separates the boundary-layer. Special attention must be paid to the turbulence modeling in order to enhance the reliability of the computational approaches. There, three turbulence models are assessed for separated flows involving shock-wave/boundary-layer interactions. The models investigated consist of the algebraic model of Baldwin-Lomax, the one-equation model of Johnson-King and the two-equation model of Coakley. A comparison of computed and measured results indicates that the Johnson-King model has the best performance and that non-equilibrium types of turbulence models are essential for accurate prediction in transonic separated flow analysis. Author

N91-12521# Kyoto Univ. (Japan).
NUMERICAL ANALYSIS OF SUPERSONIC GAS-PARTICLE TWO-PHASE FLOWS AROUND A SPHERE **c34**
Ryuji Ishii, Yoshikuni Umeda, and Masatoshi Yuhi (Mazda K. K., Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 53-57 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Unsteady supersonic gas-particle flows around a sphere are discussed. Impingement of a large particle-cloud on a shock layer of a dust-free gas in front of a sphere is numerically simulated. The effect of particles rebounded from the sphere is taken into account. It is shown that a temporal reverse flow region of the gas is induced near the body axis in the shock layer, which is responsible for the appearance of the gas flow region where the pressure gradient becomes negative along the surface. The flow region with the negative pressure gradient moves towards the downstream direction with time along the surface. These phenomena are consistent with previous experimental predictions. It is shown that the present results strongly support a flow model for the particle-induced flow field postulated in connection with heating augmentation found in the heat transfer measurements in hypersonic particle erosion environments. The particle behavior in such a flow is very complicated so that it is almost impossible to treat the particle-phase flow as an ordinary continuum medium. A few new findings are also described. Author

N91-12522# National Aerospace Lab., Tokyo (Japan).
COMPUTATION OF THREE-DIMENSIONAL CHEMICALLY REACTING FLOWS AROUND RE-ENTRY VEHICLES **c02**
Yasuhiro Wada, Satoru Ogawa, and Tomiko Ishiguro *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 59-63 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

An upwind scheme is constructed by the use of the eigenvalues and eigenvectors of the convective Jacobian matrices for the general non-equilibrium gas-dynamic equations in generalized curvilinear coordinates. This method is applied to chemically reacting hypersonic flows around a hemi-sphere cylinder and a spaceplane. The results show a splendid shock capturing capability and robustness of the scheme, revealing some characteristics of high temperature effects. Author

N91-12523# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
A HYPERSONIC THERMALLY-NONEQUILIBRIUM REACTING FLOW AROUND A THREE-DIMENSIONAL BLUNT BODY **c02**
K. V. Reddy, Toshi Fujiwara, and Toshi Murayama *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 65-70 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

This work deals with a flow around a reentry hypersonic vehicle at flight speed Mach = 31.6 under a thermally and chemically non-equilibrium concept. As a thermal non-equilibrium model, researchers adopt Park's two-temperature model using translational and vibrational temperatures of molecules. As a chemically reacting model, the modified Arrhenius form is used, where all the reaction rates depend on both temperatures. Because of the reaction delay, the distance between peripheral shock wave and the body increases from a one-temperature model. Under this concept, the reaction front is significantly separated from the shock front; the reaction delay time is accurately given by the present shock fitting method. Author

N91-12524# Fukui Univ. (Japan). Dept. of Mechanical Engineering.
NUMERICAL SIMULATION OF HIGH-SPEED COMBUSTION INDUCED BY OBLIQUE SHOCK WAVE **c25**
Shiro Taki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 71-75 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A solution-adaptive multilevel grid method is developed and applied to solve unsteady high-speed burning gas flows using an explicit finite difference method. Heating by interaction of oblique shock waves will support high-speed combustion for some conditions. In the present study, stoichiometric methane-air mixtures are considered as combustible gases, where the four-step reaction model is adopted. The diffusion of species and the heat conduction are considered, but the viscosity is neglected. The results show that in the present conditions flames are blown off, but a detonation can be formed if strong blast waves are used as an igniter. In two-dimensional generalized curvilinear space, the newly developed solution-adaptive multilevel grid method worked well for unsteady burning to reduce the lattice points to be calculated. Author

N91-12525# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL STUDY ON INJECTED JET INTO A SUPERSONIC FLOW **c02**
Masahiro Takahashi and Koichi Hayashi *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational

Aerodynamics 1989 p 77-80 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A supersonic air flow with the transverse helium injection is simulated numerically by solving the two-dimensional Reynolds averaged full Navier-Stokes equations with an algebraic eddy viscosity model developed by Baldwin and Lomax. The numerical results are compared with the experimental results to study the validity of the turbulence model and the present code. The results are also compared with the solution of a laminar flow case to study the effects of the turbulence model on the high Reynolds number flow field. The use of the turbulence model provides a better simulation of the experimental data except at the separation regions and near the injector because of a complex flow field. A modification to the algebraic model or an adoption of higher class models such as a 2-equations model is necessary to improve the simulation. Author

N91-12526# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL SIMULATION ON INVERSE JET OF SOLID ROCKET MOTOR **c20**
Koichi Hayashi and Minoru Matsuda (Mitsubishi Heavy-Industries Ltd., Nagoya, Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 81-85 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Solid particle laden two-phase inverse jet flows are studied numerically. A Total Variation Diminishing (TVD)-Upwind scheme for the gas-phase and a Flux-Vector-Splitting-Upwind scheme for the particle-phase are used to solve the two-phase Euler equations. The Eulerian formulation for the two-phase Euler flow problem is simpler in theoretical structure and more economical in computational time than the Lagrangian formulation. Numerical simulations on the single-phase and two-phase inverse jets shows the influence of solid particles on a nozzle and the flow field. An instability of the two-phase flow is also observed probably because of a numerical error. Author

N91-12527# Nagoya Univ. (Japan).
NUMERICAL SIMULATION OF A SHOCK WAVE PROPAGATION IN THE SOLID PARTICLE LAYER **c34**
Manabu Hishida and Koichi Hayashi *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 87-91 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A numerical simulation of the dust entrainment and dispersion from the dust layer behind a shock wave is performed using a two-dimensional gas-solid two-phase Euler equation to understand their mechanisms. The volume fraction of solid particles is included in the equation to consider the strong solid-phase effect. The numerical result shows that the normal shock wave above the dust layer is refracted and the pressure waves in the dust layer reflect between the shock tube floor and the surface of the dust layer. It is also shown that the dynamics of the dust layer are similar to the experimental results performed by Suzuki and Adachi. Author

N91-12528# Tokyo Univ. (Japan). Dept. of Aeronautics.
NUMERICAL ANALYSIS OF FLOW IN A SCRAMJET ENGINE **c07**
Tetsuya Sato and Shojiro Kaji *In* NAL, Proceedings of the 7th NAL Synposium on Aircraft Computational Aerodynamics 1989 p 93-97 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

In the airframe-integrated scramjet engines, the inlet flow is accompanied by a strong gradient of Mach number as well as mass flux owing to the forebody thick boundary layer which cannot be diverted outside engines because of its high temperature. If such engines are designed for uniform inlet flows, they cannot endure this type of inlet flow gradient, and a strong pressure loss occurs at the inlet. The flow mechanics of scramjet engines subject to a forebody boundary layer are investigated, and various phenomena such as compound choking and the transition of inlets from start to unstart conditions are revealed. First, the influence of boundary layers is studied by a combined one-dimensional stream tube model. Then the flow field of an engine is analyzed using a quasi-three-dimensional finite difference model. The explicit MacCormack method is used. It is shown that a scramjet engine designed for a uniform inlet flow experiences choking by the presence of a low-speed region like a boundary layer. This phenomenon is called compound choking. When a compound choking occurs, it is shown that the throat Mach number is not unity but that in the boundary layer the flow is subsonic while it is supersonic in the main stream region. The process of transition of an inlet from start to unstart conditions is shown to depend remarkably on width and shear strength of the boundary layer. It is also shown that an engine with a sweep angle is very tolerant of such flow non-uniformities. Author

N91-12529# National Aerospace Lab., Tokyo (Japan).
NUMERICAL COMPUTATION OF FLOW FOR SCRAMJET **c07**
Tomiko Ishiguro, Satoru Ogawa, and Yasuhiro Wada *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 99-104 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A numerical procedure to analyze a flowfield through or around a scramjet engine inlet is proposed. The 3-dimensional full Navier-Stokes equations in the generalized curvilinear coordinate system are solved by a time-marching method. The total variation diminishing scheme is applied for spatial discretizations of the convective terms of the equations and the implicit approximate factorization method using diagonalization for simplified inversion work is applied for the time integration. To treat boundary conditions (wall, symmetry etc.) accurately, all boundaries are mapped onto faces of rectangular parallelepipeds. A computational mesh space is made by connecting them. To show capability of this numerical procedure, numerical simulations of flow are carried out about three inlets with various sweep angles and a common V-shaped thick cowl, which are used in experiments by Kanda et al. The computational results and comparisons with their experiments are presented. Author

N91-12530# National Aerospace Lab., Kakuda (Japan).
NUMERICAL TREATMENT OF LAMINAR FLOW IN CURVED RECTANGULAR CHANNELS **c34**
Hitoshi Yamada, Hiroshi Ishigaki, and Munekazu Mochizuki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 105-109 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

The Navier-Stokes equations were solved by numerical methods for steady, fully developed, incompressible, laminar flow in curved rectangular channels. Solutions are obtained for Dean number to 550 correctly by using the power-law scheme. A Dean number to 900 can be calculated by using the up-wind scheme. The results are compared with the available experimental and theoretical results. It was found that the friction factor became larger by about 6 percent when the flow changed from the two vortex to the four vortex flow patterns, which occurred the Dean number was 116.0. The slope of the friction factor was different between the two vortex and the four vortex regions. Results showed better agreement with the experimental results than the other theoretical results. Author

N91-12531# National Aerospace Lab., Kakuda (Japan).
FLOW AND HEAT TRANSFER IN CURVED PIPE **c34**
Shuichi Ueda, Hiroshi Ishigaki, and Munekazu Mochizuki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 111-115 In JAPANESE; ENGLISH

summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Numerical solutions of the parabolized Navier-Stokes equation in connection with an energy equation are presented for steady laminar flow through a curved pipe. Predictions are presented for flow and heat transfer in the developing and fully developed regions. Results of skin friction, heat transfer, and 360-deg. bend flow meter coefficients show that comparison with experimental data exhibit good agreement. Axial velocity and stream function developments are presented in developing regions for two inlet velocity profiles of uniform and Poiseulli flows. Author

N91-12532# National Aerospace Lab., Kakuda (Japan).
NUMERICAL ANALYSIS OF HEAT TRANSFER IN A PIPE ROTATING AROUND A PERPENDICULAR AXIS **c34**
Hiroshi Tamura, Hiroshi Ishigaki, and Munekazu Mochizuki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 117-121 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

The parabolized Navier-Stokes equations are numerically solved for the laminar flow in a pipe rotating about an axis perpendicular to its axis. Simultaneously developing velocity and temperature fields are obtained for various ReR omega numbers. Numerical results of the friction factor and Nusselt numbers are compared with existing experimental data. A transition from a two-vortex secondary flow to a four-vortex secondary flow appears at high ReR omega numbers. Author

N91-12533# National Aerospace Lab., Kakuda (Japan).
NUMERICAL SIMULATION OF FLOW BETWEEN CONCENTRIC ROTATING CYLINDERS **c34**
Munekazu Mochizuki and Hiroshi Ishigaki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 123-127 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Flows between concentric rotating cylinders with non-rotating end walls are computed numerically. When inner-cylinder rotates, Taylor vortices develop in addition to secondary flow vortices. When the end walls are absent, the predicted moment coefficient compares well with experimental data. The critical Taylor number has also been predicted with good accuracy. Author

N91-12534# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
AEROTHERMAL ANALYSIS FOR GAS TURBINE COMBUSTION LINER COOLING SLOTS **c07**
Hidemi Toh, Yukinori Sato, Yasunori Ando, and Masafumi Kawai *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 129-134 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Aerothermal analysis for gas turbine combustion liner cooling slots is presented. A finite-volume numerical analysis method for the solution of three-dimensional incompressible steady Navier-Stokes equations in general curvilinear coordinate system is used for the analysis. The main solution algorithm of the method is an extension of the SIMPLE algorithm to present general curvilinear coordinate formulation. The standard k-epsilon two equations is used for the turbulence model. This method is applied to calculate the velocity, temperature, liner skin temperature distributions and cooling effectiveness. Effects of combustion liner cooling slot configuration on such distributions were examined. Author

N91-12535# National Aerospace Lab., Tokyo (Japan).
A NUMERICAL SIMULATION FOR SUPERSONIC INTAKE **c02**
Jungi Shigematsu, Kuzuomi Yamamoto, and Atsushige Tanaka (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 135-139 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A supersonic inlet flow with strong viscous effect was numerically simulated by solving two-dimensional Navier-Stokes equations. In this simulation, the Harten-Yee's Total Variation Diminishing (TVD) scheme is employed for sharp shock resolution and numerical stability. Numerical results successfully simulate strong viscous effects similar to those of wind tunnel tests. Author

N91-12536# National Aerospace Lab., Tokyo (Japan).
A NUMERICAL ANALYSIS OF THE FLOW IN A CASCADE WITH TIP CLEARANCE **c34**
Toshinori Watanabe, Isao Kanazawa (National Space Development Agency, Tokyo, Japan), Osamu Nozaki, and Atsuhiro Tamura *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 141-146 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

The three-dimensional flow field through a linear cascade with tip clearance was numerically studied by solving Navier-Stokes equations. A fundamental cascade model composed of flat plates, on which corresponding experimental data were available, was adopted to develop the appropriate solution method for the flow through the tip clearance. Computational grids were generated by a zonal method. Two-dimensional C-type grids were made around blades and stacked from the hub wall to the tip wall. The region between the tip surface of the blade and the tip wall was filled with H-type grids. The computed normal force distributions on blades and velocity vectors in the downstream flow field showed good qualitative agreement with the experimental data. The detailed flow phenomena around the blade tip, such as the formation of separation bubbles on the tip surface, were clearly described. The spanwise distributions of the normal force on the blade were investigated for various tip clearances, and it was found that the normal force on the extremity of the blade did not diminish in the case of small clearances of less than 0.6 percent of the blade span because of the blockage of leakage flow due to the effect of viscosity. Author

N91-12537# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF THE FLOWFIELD THROUGH A TURBINE BLADE ROW WITH TIP CLEARANCE **c07**
Osamu Nozaki, Atsuhiro Tamura, Toshinori Watanabe, and Isao Kanazawa (National Space Development Agency, Tokyo, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 147-154 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Three dimensional viscous flowfields through a linear turbine blade row with tip clearance leakage were numerically simulated. Flowfields were decomposed to a H-grid region on the blade tip and a C-grid one around it. Navier-Stokes equations were solved in each of them and the boundary conditions between them were connected with each other. In case of low incidence angle, the computed results for the total pressure loss in a downstream section and limiting streamlines in a horizontal section showed qualitatively good agreement with experimental data. Author

N91-12538# Tohoku Univ., Sendai (Japan). Dept. of Mechanical Engineering.
NUMERICAL SIMULATIONS OF TRANSONIC CASCADE FLOW AND THEIR VISUALIZATIONS **c34**
Satoru Yamamoto and Hisaaki Daiguji *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 155-160 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Researchers propose implicit time-marching finite-difference

methods for solving the three-dimensional compressible Euler and Navier-Stokes equations which were composed of the momentum equations of contravariant velocities. By using these methods, such boundary conditions as the solid wall b.c. and the periodic b.c. for 3-D impeller flows can be treated easily. An TVD upwind scheme and a two-equation k-epsilon turbulence model were also employed. The purpose is to first visualize the computer results of the 3-D compressor cascade flow by using 3-D Computer Graphic (CG) techniques such as the particle paths, oil flows and time lines, and second to extend methods for obtaining steady-state solutions to a numerical method for solving the unsteady cascade flow such as a turbine stator-rotor interaction. Author

N91-12539# Kyushu Univ., Fukuoka (Japan). Dept. of Mechanical Engineering for Power.
A ZONAL APPROACH FOR SOLUTIONS TO THE COMPRESSIBLE NAVIER-STOKES EQUATIONS USING A TVD FINITE VOLUME METHOD **c34**
Masato Furukawa, Masao Yamasaki, and Masahiro Inoue *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 165-170 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A new zonal approach for the computation of compressible viscous flows was developed. In the present approach, a highly accurate Total Variation Diminishing (TVD), finite volume formulation with the composite zonal grid system is implemented in order to produce a Navier-Stokes solver with robustness and high accuracy. The emphasis here is on the treatment of the zonal boundary. In the present zonal approach, the zonal boundary is constructed of interfaces of computational cells, and the communication from one zone to the other is accomplished by numerical fluxes across the zonal boundary. The complete conservation of the fluxes at the zonal boundary can be satisfied by directly evaluating the fluxes using the finite volume formulation and by ensuring the uniqueness of the zonal boundary between two zones. Author

N91-12540# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
A GRID GENERATION ON BODY SURFACE USING MASTER DIMENSION SYSTEM **c61**
Hiroshi Wakai *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 171-176 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A method for generation of structural 3-D body surface grids is described. The present grid generation procedure is based on the use of the interpolation function of MASTER DIMENSION SYSTEM, which is used to define the wind tunnel test model shape, and which generates the body surface grid, automatically satisfying several geometrical requirements. The advantage of this method is that we can improve the efficiency of grid generation work and make grids quickly corresponding to the change of wind tunnel test model shape. A typical example is the grid around a wing-body configuration generated by this method. The results of a Navier-Stokes analysis are presented. Author

N91-12541# Osaka Univ. (Japan). Dept. of Aeronautical Engineering.
TOWARD THE AUTOMATIC FLOW SOLVER **c34**
Kazuhiro Nakahashi *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 177-183 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

For achieving an automation of flow computations, a fully-automatic grid generator together with an unstructured upwind method are developed. The unstructured grid is generated using two techniques; geometry-adaptive refinement and solution-adaptive refinement. The geometry-adaptive refinement introduces the information of flowfield geometry into the grid, and the solution-adaptive refinement introduces the fluid physics. A combination of these two techniques enables a fully automatic grid generator in which the user is not always requested to have knowledge of and experience in Computational Fluid Dynamics (CFD). The flux-vector splitting method of Van Leer for the Euler equations is extended for the use on the arbitrarily-shaped unstructured meshes. This robust upwind flow solver with the automatic grid generator can be a useful CFD tool for engineering routine works. The method is applied to external and internal flow problems to demonstrate its capability. Author

N91-12542# Institute of Computational Fluid Dynamics, Tokyo (Japan).
STRUCTURED GRID GENERATION BASED ON UNSTRUCTURE GRID **c61**
Masahiro Suzuki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 185-187 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

An idea of structured grid generation is presented. To save the user work, an unstructured grid is generated, then a partial differential equation is solved by finite element method on the grid. Finally, a structured grid is obtained by searching contour lines on the solution. Author

N91-12543# National Aerospace Lab., Tokyo (Japan).
A NEW ALGORITHM FOR GENERATING BLOCK-STRUCTURED GRID AND ITS APPLICATION TO COMPLEX AIRCRAFT CONFIGURATIONS **c61**
Susumu Takanshi and Motomu Sato (Meitec Ltd., Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 189-193 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A grid generation procedure using a simple algorithm is presented. The present method is essentially based on the electrostatic theory. By distributing electric charges at the boundary points, an electro-static vector field is produced inside the region between the inner and outer boundaries. The resulting electric force lines, which all emanate from the grid points on the body, can be utilized as one family of grid lines. The other family of grid lines is easily constructed by regularly-plotting points along the electric force lines. The electric charge distribution is uniquely determined by the appropriate boundary condition, so far as the total amount of charges on each closed-boundary is constant. The practical application of the present method was successfully made to complex aircraft configurations. Author

N91-12544# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF FLOW FIELDS AROUND AN AIRPLANE OF COMPLEX GEOMETRIES **c02**
Masakazu Tachibana and Susumu Takanashi *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 195-199 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A numerical aerodynamic simulation system applicable to various complex geometries was developed. Researchers use an O-O type of grid in order to concentrate grid points in wall boundary layers effectively and to implement wall and outer boundary conditions easily. In addition, on the body surface, the grid is divided into several blocks which have common points at each interface. By doing so, a finite volume algorithm can be applied easily and the Navier-Stokes code using this grid became adaptable to various kinds of airplanes. As a first example, we tried to compute the flowfield around a practical aircraft configuration, and also compared the solution with the wind tunnel test data. Author

N91-12545# National Aerospace Lab., Tokyo (Japan).
GENERATION OF 3-D GRID USING BOUNDARY ELEMENT METHOD **c61**
Mitsunori Yanagizawa, Masaaki Nakadate, Yasuhiro Koshioka, and

Atushi Inoue (Fuji Heavy Industries Ltd., Utsunomiya, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 201-207 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A computational procedure for generating three-dimensional grids around wing-fuselage configurations is presented. Use is made of Green's theorem to obtain the required solution use of the panel methodology. Then the lines of force and equipotential surfaces surrounding the configuration determine a body-conforming orthogonal grid. Application of the method to several test cases shows that the grid for a forebody is made smooth and continuous and that the grid for a civil transport plane is created. A finite-volume Euler solver is adapted to the grid system. Computed inviscid compressible flow solutions about the civil transport plane are present. Author

N91-12546# Ship Research Inst., Tokyo (Japan).
USE OF SPLINE FUNCTIONS IN CFD **c34**
Yoshiaki Kodama *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 209-213 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Spline functions are often used for interpolating discrete functions. Here the use of spline functions in various stages of computational fluid dynamics (CFD), i.e., grid generation, flow solver, and postprocessing is described. The simplest of the spline functions are cubic splines. With the addition of tension, tension splines are defined. The addition of convection produces convection splines. Parametric bi-cubic splines are used to define body surface geometry. Then the grid points on the surface can be shifted arbitrarily along the surface to produce an optimum body-surface grid. A scalar linear convection equation is computed using cubic splines. There the energy as well as momentum is conserved. In the postprocessing of the computed flow, it is sometimes necessary to interpolate values at arbitrary spatial locations. There the parametric multi-direction splines are used for interpolation. Multi-direction splines can also be used for streamline-tracing. Coordinate values and velocity vectors are interpolated, and a streamline is traced semi-analytically in the spline space. Author

N91-12547# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF THE KNUDSEN LAYER DYNAMICS USING THE DIRECT SIMULATION MONTE CARLO METHOD **c61**
Sadamu Saito (Nippon Electric Co. Ltd., Tokyo, Japan) and Katsuhisa Koura *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 215-220 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Numerical simulation of the Couette flow problem is carried out using the Direct Simulation Monte Carlo (DSMC) method. Velocity profiles in the Knudsen layer obtained using the DSMC method are compared with variable analytical solutions of the simplified Boltzmann equation and experimental results. The comparison shows satisfactory agreement among the three when the speed of the walls is small. Then, it is demonstrated that the DSMC method is applicable to the dynamical simulation of gas, even when the speed of the flow is smaller than the typical molecular thermal speed. Author

N91-12548# National Aerospace Lab., Tokyo (Japan).
RAREFIED GAS NUMERICAL WIND TUNNEL. 5: VORTEX SHEDDING BEHIND AN INCLINED FLAT PLATE **c02**
Katsuhisa Koura and Emi Kanematsu (Fujitsu Ltd., Tokyo, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 221-224 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

The rarefied gas numerical wind tunnel with the universal code described using the null-collision direct-simulation Monte Carlo method is used for the simulation of the vortex shedding in dilute gas flows past an inclined flat plate at the incidence angle 45 deg. The results obtained for the freestream Mach number M(infinity) = 0.7 and Knudsen numbers Kn(infinity) = 1/60 and 1/200, for which the freestream Reynolds numbers Re(infinity) = 69 and 230, respectively, clearly show the vortex shedding in the wake region of the plate. The Strouhal number is about 0.2, which is rather larger than about 0.15 under continuum (incompressible) flow conditions. It is also found that the well-defined vortex structure disappears at rather small Knudsen number K(infinity) approx. greater than 0.1 for M(infinity) = 0.7 or at rather small Mach number M(infinity) approx. greater than 2 for K(infinity) = 1/60. Author

N91-12549# Kawasaki Heavy Industries Ltd., Kagamihara (Japan).
THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING. 7: A SIMPLE ANALYSIS METHOD OF SEPARATING FLOWS **c34**
Takashi Uchida and Eiji Shima *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 225-229 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

It is important to develop simple analysis methods of flows for aircraft design. A simple analysis method of two dimensional separating flow is described. The method is based on potential flow theory and experimental data. The results of this method are compared with then calculated by a Navier-Stokes code. Agreement between the former results and the latter is good. Author

N91-12550# National Aerospace Lab., Tokyo (Japan).
COMPARATIVE STUDY ON WING PRESSURE DISTRIBUTION OF HIGH SPEED JET AIRPLANE BETWEEN NUMERICAL SIMULATION AND FLIGHT TEST **c02**
Junichi Miyakawa (Mitsubishi Heavy-Industries Ltd., Tokyo, Japan) and Susumu Takanashi *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 231-236 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Computational aerodynamics has evolved to be a practical design tool comparable to wind tunnel testing, and it has played an important role in actual aircraft design stages. There have been intensive works already done for code validation to support the accuracy of the computation. The code accuracy based upon comparison between numerical simulation and actual flight test is discussed for the first time. Author

N91-12551# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF TRANSONIC FLOWS OVER BOEING-747 AND ITS VALIDATION BY COMPARISON WITH EXPERIMENTAL DATA **c02**
Ryozo Ito, Susumu Takanashi, Kisa Matsushima, Motomu Sato, Kozo Fujii, and Edward N. Tinoco (Boeing Commercial Airplane Co., Seattle, WA.) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 237-241 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

The viscous transonic flow simulations over a B747 wing-fuselage combination were carried out using the three-dimensional Reynolds-averaged thin-layer Navier-Stokes equations. The single grid system in C-O topology is used for these computations, and it has 1.1 million grid-points. Computed results such as total lift and pressure distributions on the wing are in good agreement with the wind tunnel test data. Author

N91-12552# Tottori Univ. (Japan). Dept. of Applied Mathematics and Physics.
NUMERICAL SIMULATION OF WING IN GRAND EFFECT 2 **c02**
T. Kawamura and Shozo Kubo *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 243-247 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Flow around a wing in ground effect is studied by solving both the incompressible and compressible Navier-Stokes equations numerically. A standard marker-and-cell (MAC) method with third order upwind difference for the non-linear term is used to calculate incompressible flow. For compressible flow, a new numerical scheme is developed. Both schemes run well and researchers can investigate numerically the effect of the distance from the ground, that of attack angle and that of the oscillation of the wing on the flow field and the force acting on the body. Author

N91-12553# National Aerospace Lab., Tokyo (Japan).
EFFECTS OF BLADE TIP PLANFORMS ON ROTOR PERFORMANCE IN HOVER **c02**
Takashi Aoyama, Keiji Kawachi (Tokyo Univ., Japan), and Shigeru Saito *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 249-254 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A calculation method is developed to analyze the flow around a helicopter blade in hover. Aerodynamic loads generated by a blade are calculated by solving the three-dimensional Euler equations in a rotating coordinate system on body-conforming curvilinear grids around a blade. These equations are solved by employing a Beam-Warming scheme. A Total Variation Diminishing (TVD) scheme is used in order to capture the accurate shock wave. The local induced velocity generated by the rotor-wake is taken into the calculation by subtracting the equivalent angle of attack along the blade from the geometrical one. This equivalent angle of attack is calculated by using prescribed-wake vortex theory. The ability of the present method is verified in comparison with the results of the experiment and the analytical method. In addition, the effects of the planforms of a blade tip on the performance of a helicopter rotor and on the flow around a blade in hover are analyzed. The comparison among swept-back, tapered and swept-back tapered tips is presented. As a result, one tip planform, which has sweep-back angle and inverse-taper, is found to improve the performance of the rotor. Author

N91-12554# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
A PRELIMINARY STUDY OF TRANSONIC FLOW AROUND NACA0012 **c02**
Andi E. Sakya, Yoshiaki Nakamura, and Michiru Yasuhara *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 255-264 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A typical transonic flow at M(infinity) = 0.80 and Re = 1 x 10(exp 6) is numerically simulated by using the Yee-Harten Total Variation Diminishing (TVD) Scheme of the Euler Backward Implicit method. This study treats unsteady, inviscid or viscous compressible flows. In the viscous flow case, two turbulence models are applied: the Baldwin-Lomax model (BLM) and the Stock-Haase model (SHM). Comparison with the experimental data shows a good agreement. Author

N91-12555# National Aerospace Lab., Tokyo (Japan).
TRANSONIC AERODYNAMICS ANALYSES OF UNCONVENTIONAL WING CONFIGURATIONS BY 3D-EULER CODE **c02**
Masakata Hashimoto (Mitsui Engineering and Shipbuilding Co. Ltd., Tokyo, Japan), Naoki Hirose, and Takeshi Ohnuki *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 265-271 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

New wing configurations such as a forward-swept-wing and a joined-wing recently attracted attention and are studied with expectations for higher lift-to-drag ratio, wider range of aileron effectiveness, or higher drag divergence Mach number than the conventional ones. Here, a computational code especially developed for analyzing the transonic aerodynamics of the new wing configurations is presented. The code is based on a system of Euler equations which are solved by the time-split MacCormack's scheme. Computational results of lift, drag and pressure distribution characteristics of the forward-swept-wing and the joined-wing configurations are shown and discussed in comparison with those of the conventional aft-swept wing. Author

N91-12556# National Aerospace Lab., Tokyo (Japan). Computational Aerodynamic Section.
AERODYNAMIC SIMULATION OF FLOWS ABOUT A SPACE-PLANE 3 **c02**
Kisa Matsushima, Susumu Takanashi, and Kozo Fujii (Tokyo Univ., Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 273-278 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Three dimensional flowfields about a winged space vehicle at supersonic speed were numerically simulated using Navier-Stokes equations. The present model of the vehicle is under study at the National Aerospace Laboratory as a candidate Japanese future aerospace vehicle. Here, interest is concentrated on the understanding of the effect of the tail wing on the shape of the vehicle. So, two different simulations were conducted; one is for the flowfields about a whole configuration model (WBT Model) and the other is about a wing-body combination model (WB Model). The vortical flow phenomena due to high angle of attack are so complicated that a more careful consideration is necessary. The numerical results show the difference clearly between those two flowfields. The aerodynamic forces and coefficients computed from the simulation results are in good agreement with experimental data. Author

N91-12557# National Aerospace Lab., Tokyo (Japan).
ON THE NUMERICAL SIMULATIONS OF FLOW AROUND A BODY OF COMPLEX CONFIGURATIONS **c34**
Satoru Ogawa, Yasuhiro Wada, Tomiko Ishiguro, and Yoko Takakura *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 279-284 In JAPANESE; ENGLISH summary Prepared in cooperation with Fujitsu Ltd., Tokyo, Japan (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

The grid embedding scheme is used to solve the whole flowfields around the combined configuration of the Hope, H-II rocket and rocket booster designed by the National Space Development Agency (NASDA). Three computational grids are overlapped with each other and the solutions are combined by interpolation at the boundaries. The Harten type Total Variation Diminishing (TVD) scheme is used to solve the Euler equations for hypersonic flow from M = 1.3 to 2.5, and it is shown the results of numerical simulation using the present methods are reasonable. Author

N91-12558# National Aerospace Lab., Tokyo (Japan).
VERIFICATION OF NUMERICAL SIMULATION CODES FOR HYPERSONIC VISCOUS FLOW AROUND A SPACE PLANE **c34**
Yukimitsu Yamamoto, Haruhiko Arakawa, and Ryuji Yoshida (Mitsubishi Heavy-Industries Ltd., Tokyo, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 285-293 In JAPANESE; ENGLISH

summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Recent progress of super computers and numerical schemes enables us to use computational fluid dynamics (CFD) as the main tool for designing the optimum configuration of the hypersonic vehicles. However, before using CFD for such purposes, verification of the CFD code is necessary. In the present study, a flux-split upwind TVD Navier-Stokes code was applied to the hypersonic flow around space planes proposed by the National Aerospace Laboratory (NAL). Numerical results are compared with experiments in the hypersonic wind tunnel at NAL and accuracy and reliability of the present code are examined. Through these comparisons, it is demonstrated that the present code gives excellent agreements with experimental data on surface pressure distributions and aerothermodynamic heating. Author

N91-12559# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF HYPERSONIC FLOW AROUND H-2 ORBITING PLANE **c02**
Yukimitsu Yamamoto, Toshio Akimoto, and Naoyuki Suzuki (AES, Inc., Tsukuba, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 295-301 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

An unmanned winged vehicle for space transportation called the H-II Orbiting Plane (HOPE) was studied by the National Space Development Agency of Japan (NASDA). The gross weight is planned about 9.0 tons at launch with the payload of about 1.2 tons. The current baseline configuration of the HOPE has a double delta wing with tip fins. The double delta type wing planform is expected to have smaller longitudinal trim change over all the flight regions. Tip fins are adopted in order to gain easier access to Space Station or other platforms. Hypersonic computational fluid dynamics (CFD) analyses were performed for the 62A, 62B, and 62C HOPE configurations in order to investigate lateral and directional aerodynamic characteristics. This work has been done as the joint research of National Aerospace Laboratory (NAL) and NASDA. Numerical computations were carried out at M(infinity) = 7.0 and Reynolds number of 2.5 x 10(exp 6) at angles of attack 0, 20 and 40 degrees with yaw angle of 5 deg. Numerical results were compared with experimental data obtained from the hypersonic wind tunnel (HWT) at NAL. Author

N91-12560# Shimizu Corp. (Japan). Dept. of Civil Engineering.
STUDY OF ACCURACY AND PERFORMANCE OF MODIFIED EULER SCHEME WITH FINITE ELEMENT METHOD ON FLOW PROBLEM **c34**
Wako Takanashi *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 303-306 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

The formulation of new upwind scheme using the finite element method for flow problems is discussed. High accuracy of the modified Euler scheme is generated streamline upwind and artificial viscosity depends on incremental time step in the second order of conventional term. Lumped mass matrix does not require a great amount of computing time, and core memory is employed. This formulation could be applied to compressible and incompressible viscous flow problems. Author

N91-12561# National Aerospace Lab., Tokyo (Japan).
THE APPLICATION OF THE CONSISTENCY TO CHARACTERISTICS TO IMPLICIT DIFFERENCE APPROXIMATION **c64**
Hideaki Aiso *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 307-312 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

Consistency of characteristics is a concept defined on difference approximation to conservation laws to make the analogue of characteristics of conservation laws. Using this concept, researchers can estimate the propagation of a sufficiently small perturbation on a difference-approximated solution by comparing it with one on the solution to the original conservation law. Researchers have already obtained a sufficient condition upon which explicit 3-point approximation has the consistency to characteristics. Researchers discuss a sufficient condition upon which fully implicit 3-point difference approximation has the consistency of characteristics. In the case of conservative difference approximation, whether explicit or implicit, the condition is stated in terms of numerical flux. In explicit and implicit cases, the numerical fluxes with the consistency of characteristics constitute one parameter family. But they are different and have only one member in common, which is the one used in the upwind difference approximation without any viscosity. This fact indicates different propagation phenomena of explicit and implicit difference approximation. Author

N91-12562# National Aerospace Lab., Tokyo (Japan).
FINITE ELEMENT SOLUTION OF NAVIER-STOKES FLOW AROUND AEROFOILS: ACTIVE USE OF BLOCK TRIDIAGONAL MATRIX **c34**
Masashi Shigemi *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 313-320 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

A finite element method which is designed to solve the incompressible Navier-Stokes equations through the application of the penalty function method has been proved to be robust and reliable. A shortcoming of this approach is its expensiveness; it requires long computation time and large memory area. This is because a large system of linear equations has to be solved repeatedly by this method. This system of linear equations has a band structure, and a structure as a block tridiagonal matrix. An efficient method to solve it is shown here. In this new method, all elements of the coefficient matrix are not evaluated at a stretch, but evaluated block by block. Since all block matrices, which are subsets of the global coefficient matrix, share the same memory area and are stored in it one by one, the memory area necessarily becomes small. The basic method applied here to solve the system of linear equations is the LU-decomposition of the coefficient matrices and subsequent forward and backward substitutions. Such operations as the LU-decomposition, forward substitution and backward substitution are conducted not in the element level but in the block matrix level. This method gives a theoretically exact solution. To improve the efficiency of the solution, it is possible to introduce an approximation into the procedure when flows around a thin obstacle such as an airfoil are concerned. Author

N91-12563# American Inst. of Aeronautics and Astronautics, New York, NY. General Aviation Systems Technical Committee.
PROCEEDINGS OF THE 1990 AIAA/FAA JOINT SYMPOSIUM ON GENERAL AVIATION SYSTEMS
Augusto Ferrara, comp., Dave Lawrence, comp., and Janine Blake, comp. May 1990 396 p Symposium held in Ocean City, NJ, 11-12 Apr. 1990 Prepared in cooperation with FAA, Atlantic City, NJ
(DOT/FAA/CT-90/11) Avail: NTIS HC/MF A17

The 1990 American Institute of Aeronautics and Astronautics (AIAA)/Federal Aviation Administration (FAA) Joint Symposium on General Aviation Systems was the result of the combined efforts of the AIAA General Aviation Systems Technical Committee and the Federal Aviation Administration Technical Center. This symposium offered the opportunity to present and review the current state of the art in research that is being conducted in support of general aviation. All told, the papers presented covered the entire spectrum of research and the participants had the opportunity to hear presentations on everything from alternate fuels to developments in air traffic control. For individual titles, see N91-12564 through N91-12578.

N91-12564# Ebasco Services, Inc., Lyndhurst, NJ. Corporate Quality Programs Div.
SOFTWARE SUPPLIER EVALUATION AND ASSESSMENT **c61**
R. Kosinski and J. M. Gushue *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 2-15 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

In the design of general aviation aircraft, current technology involves the use of advanced application software. Advanced software systems are called upon to provide reliable and accurate solutions. Software systems enhance our ability to understand complex forces and processes. Thus, the process of software development and maintenance can't be ignored if the aircraft industry is to rely on these advanced systems for the design of state of the art aircraft and the safety of the flying public. Fotential users of advanced application software must establish a level of confidence in the product before it can be applied to engineering and design situations. A software supplier control program can help to provide the necessary level of assurance that advanced application software will perform as required. Software supplier control programs can help enhance our confidence in the software through an evaluation of the supplier's Software Quality Assurance Program (QA), an evaluation of its implementation and an assessment of a supplier's software engineering capability. Supplier evaluations or audits are a proven technique used to examine suppliers' QA programs, and to determine the acceptability and implementation of the program. The software engineering capability assessment is a technique used to assess the capability of an organization to support and use modern software engineering technology. The emphasis of the software engineering capability assessment is on identifying and promoting modern software development and maintenance processes and practices within the supplier's organization which, in turn, support desirable quality characteristics in the software and software process. Author

N91-12565# IIT Research Inst., Bartlesville, OK. National Inst. for Petroleum and Energy Research.
ETBE IN GENERAL AVIATION AIRCRAFT ENGINES Abstract Only **c28**
William F. Marshall *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 54-55 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

Tests were conducted to determine the potential of using ethyl tertiary-butyl ether (ETBE) as a fuel for light aircraft engines. An engine was installed on a test stand and operated at two speed-load conditions with five fuels. The fuels were avgas, an unleaded premium autogas, blends of ETBE in the autogas, and neat ETBE. The air-fuel mixture was controlled at five different stoichiometries at each engine mode. Engine performance and exhaust emissions were measured at each condition. The exhaust emissions measurements included hydrocarbon speciation and aldehydes as well as total hydrocarbon, CO, NOx, O2, and CO2. Results show that the engine performance achieved with ETBE (either blended or neat) was equivalent to that with hydrocarbon fuels. Thermal efficiency was slightly higher for ETBE. However, the lower emission rates of the reactive components with ETBE yields a net effect of lesser effect on air quality. Author

N91-12566# Federal Aviation Administration, Atlantic City, NJ.
FLIGHT TESTING WITH ETANOL IN TURBOPROP ENGINES **c28**
Keith J. Biehl and Paul S. Demko *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 56-65 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

Limited flight testing was conducted to evaluate the performance characteristics and functional suitability when operating on a blend of 10 percent ethanol alcohol with JP-4 jet fuel. Of the 37 hour flight test effort, 20.3 hours were conducted with ethanol blended fuel in the starboard PT6A-41 engine of a Beechcraft King Air 200. Data collection was conducted at 6,000 foot intervals from ground level up to 30,000 feet utilizing steep climb to interval altitudes, continuous climbs and endurance cruise profiles. Ethanol fuel blending was not conducted before flight but rather during flight utilizing a separate onboard ethanol tank with associated fuel lines and mixing valves. This procedure allowed for consistent control of the desired 10 percent fuel mixture and allowed for a stable mixture with no possibility of phase separation. While a noticeable power reduction was present when operating with an ethanol mixture, no detrimental conditions were noted. In addition, an engine hot section inspection was performed both before and after flight test operations were completed. No degradation of components were noted by the overhaul facility and the only fuel related part change was a fuel control unit diaphragm. This part change was accomplished during the post flight test inspection as a precaution only. Author

N91-12567# Wichita State Univ., KS. Inst. for Aviation Research.
THE ENHANCEMENT OF AIR TRAFFIC CONTROL SAFETY THROUGH PRE-HIRE UNIVERSITY BASED TRAINING PROGRAMS **c04**
Brent D. Bowen *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 82-107 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

A potential means to enhance air traffic control safety through increased human performance capabilities of the nation's Air Traffic Controller Work Force is proposed. Research data was gathered from colleges and universities participating in the Federal Aviation Administration's (FAA) Airway Science Program. The Federal Aviation Administration initiated the Airway Science Program in 1983 to facilitate the development of collegiate education programs as a means of meeting future FAA manpower needs, primarily in the area of air traffic control. The FAA realized that it must update the skill level of its work force to adapt to an increasingly technical and automated environment. This is a major undertaking in that the upgrading of this work force will require the attrition of over 45,000 individuals. Currently, 32 institutions of higher education participate in the Airway Science Program. These institutions represent many established colleges and universities which offer aviation educational programs developed by the FAA. Research data gathered through this study should allow the Federal Aviation Administration to better understand the potential of the Airway Science Program to enhance air traffic safety. This program allows the availability of a means of pre-hire training through a baccalaureate degree program which stresses technical and managerial capabilities. This will provide an air traffic control work force with the increased human performance capabilities which are required to staff the increasingly difficult systems of our rapidly developing National Airspace System. Author

N91-12568# Wichita State Univ., KS. Dept. of Mechanical Engineering.
DYNAMIC BEHAVIOR OF THE HUMAN BODY SUBJECTED TO IMPACT CONDITIONS WITH AND WITHOUT RESTRAINT **c52**
Hamid Lankarani, Deren Ma, and Gayle Ermer *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 108-131 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

A simple multiple-segment model of the human body is developed in order to examine its dynamic response under the action of external forcing conditions. The system is modeled as a collection of rigid elements interconnected by an array of kinematic joints constraining the relative motion of the elements. These elements include upper body combined with head and neck, lower legs, and thighs. Nonlinear rotational springs are incorporated at the joints accounting for the anatomical characteristics and limits. The constructed model is used to simulate the post-crash behavior of an aircraft pilot or passenger during surges such as frontal/side collisions and crashes in the vertical plane. A mathematical

representation of the seat and interaction of the passenger with the seat cushion and back is developed. Restraints representing the seatbelts are also introduced in the model in a few different configurations. The complete model is then subjected to various pulse accelerations or decelerations in different directions. To perform a dynamic analysis, a three-dimensional code is developed that generates and numerically solves the governing differential equations of motion in a systematic fashion. This feature of generality allows future additions to the present simple model or construction of more advanced models in a convenient way. This computerized model and the results of the simulations provide a base for predicting the motion behavior of the human body parts during crashes, understanding the effects of various types of seats and seatbelts on passenger safety, and design of mechanisms for crash protection and cockpit/cabin interior elements. Author

N91-12569# John Deere Technologies International, Inc., Wood-Ridge, NJ.
ADVANCED STRATIFIED CHARGE ROTARY ENGINE TECHNOLOGY FOR GENERAL AVIATION SYSTEMS c07
Robert S. Mount and Edward S. Wright *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Avaiation Systems May 1990 p 202-221 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

Technology enablement activities in progress at John Deere Technologies International, Inc., Rotary Engine Division, toward advanced stratified charge rotary engines are discussed. Specific references are made to critical component technology needs and the supportive research and technology in progress. Included are multi-fuel aspects, fuel economy, combustion modeling, advanced turbomachinery, fuel injection systems, performance objectives and progress to date. Long range goals and potential for meeting advanced aviation system needs, in propulsion and auxiliary power unit areas for commercial and military systems, are discussed, including projected market potential and strategies. Author

N91-12570*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN EVALUATION OF AUTOMATIC CONTROL SYSTEM CONCEPTS FOR GENERAL AVIATION AIRPLANES c08
E. C. Stewart *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 236-259 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17 CSCL 01C

A piloted simulation study of automatic longitudinal control systems for general aviation airplanes has been conducted. These automatic control systems were designed to make the simulated airplane easy to fly for a beginning or infrequent pilot. Different control systems are presented and their characteristics are documented. In a conventional airplane control system each cockpit controller commands combinations of both the airspeed and the vertical speed. The best system in the present study decoupled the airspeed and vertical speed responses to cockpit controller inputs. An important feature of the automatic system was that neither changing flap position nor maneuvering in steeply banked turns affected either the airspeed or the vertical speed. All the pilots who flew the control system simulation were favorably impressed with the very low workload and the excellent handling qualities of the simulated airplane. Author

N91-12571# University of Western Michigan, Kalamazoo. Dept. of Aircraft and Automotive Engineering.
PERFORMANCE INSTRUMENTATION FOR MULTIENGINE SAFETY c03
Arthur W. Hoadley *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 260-279 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

Many accidents in multiengine aircraft are caused by the pilot's inability to retain control and/or obtain maximum performance when an engine fails. In order to maintain control of the aircraft, the pilot must not allow the aircraft to stall with the asymmetric thrust caused by a failed engine. The strong yawing moment that results, coupled with the stall, will most likely result in a spin. Several training accidents have been caused by demonstrating Vmc (minimum controllable airspeed) at a sufficiently high altitude, where the lower engine thrust causes the Vmc to be below the stall speed of the aircraft. When the aircraft stalls before Vmc is reached, an unrecoverable spin can occur. Instrumentation designed to give the pilot a continuous display of the aircraft's stall margin (the percent of lift coefficient available but not being used) allows the pilot to know where the aircraft is relative to stall, regardless of its load factor, weight, or configuration. The same technology can be used to detect the sideslip of an aircraft with asymmetric thrust. An aircraft's best single engine performance is obtained when the sideslip is zero and the stall margin for best climb is flown. During an engine out emergency, the pilot would control the stall margin with pitch changes and the sideslip by adjusting the bank angle, while using the rudder to maintain directional control. The theory and hardware necessary to provide both stall margin and sideslip indications are discussed. Author

N91-12572*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN AIRFOIL FOR GENERAL AVIATION APPLICATIONS c02
Michael S. Selig, Mark D. Maughmer (Pennsylvania State Univ., University Park.), and Dan M. Somers *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 280-291 (For primary document see N91-12563 04-01)
(Grant NGT-50341)
Avail: NTIS HC/MF A17 CSCL 01A

A new airfoil, the NLF(1)-0115, has been recently designed at the NASA Langley Research Center for use in general-aviation applications. During the development of this airfoil, special emphasis was placed on experiences and observations gleaned from other successful general-aviation airfoils. For example, the flight lift-coefficient range is the same as that of the turbulent-flow NACA 23015 airfoil. Also, although beneficial for reducing drag and having large amounts of lift, the NLF(1)-0115 avoids the use of aft loading which can lead to large stick forces if utilized on portions of the wing having ailerons. Furthermore, not using aft loading eliminates the concern that the high pitching-moment coefficient generated by such airfoils can result in large trim drags if cruise flaps are not employed. The NASA NLF(1)-0115 has a thickness of 15 percent. It is designed primarily for general-aviation aircraft with wing loadings of 718 to 958 N/sq m (15 to 20 lb/sq ft). Low profile drag as a result of laminar flow is obtained over the range from c sub l = 0.1 and R = 9x10(exp 6) (the cruise condition) to c sub l = 0.6 and R = 4 x 10(exp 6) (the climb condition). While this airfoil can be used with flaps, it is designed to achieve c(sub l, max) = 1.5 at R = 2.6 x 10(exp 6) without flaps. The zero-lift pitching moment is held at c sub m sub o = 0.055. The hinge moment for a .20c aileron is fixed at a value equal to that of the NACA 63 sub 2-215 airfoil, c sub h = 0.00216. The loss in c (sub l, max) due to leading edge roughness, rain, or insects at R = 2.6 x 10 (exp 6) is 11 percent as compared with 14 percent for the NACA 23015. Author

N91-12573# Goldschmied (Fabio R.), Monroeville, PA.
AERODYNAMIC TRANSPORT EFFICIENCY OF GENERAL AVIATION: AN OVERVIEW c03
Fabio R. Goldschmied *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 292-311 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

An extensive overview has been carried out on the Aerodynamic Transport Efficiency, as defined by Gabrielli and von Karman, of General Aviation aircraft, using data from many published sources, including the 1988 and 1989 Tri-aviathon races and the 1970 Oshkosh Aircraft Efficiency Contest races. The best result from the races was an efficiency of 6.19 at 91 m/s (204 MPH) for a four-seat aircraft. It was also shown that an efficiency of 14.8 can be achieved with a NASA fuselage/wake-propeller configuration

and 12.9 with a Navy fuselage/pressure-thrust configuration of comparable gross weight and speed. On the basis of the Kraus cruise Figure-of-merit, this would mean that new advanced aircraft would have the same merit value as used conventional aircraft, for the same purchase price; thus the buyer would be strongly motivated to buy the new aircraft, revitalizing the General Aviation industry. Author

N91-12574# Honeywell, Inc., Glendale, AZ. Commercial Flight Systems Group.
GULFSTREAM 4 FLIGHT MANAGEMENT SYSTEM c05
Steven C. Runo *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 312-329 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

In February 1990, the Gulfstream IV (G-IV) received Federal Aviation Administration (FAA) certification of the most advanced flight management system (FMS) available on business aircraft. This certification completed the Honeywell SPZ-8000 Digital Automatic Flight Control System (DAFCS) that is standard on all G-IVs. Vertical guidance, aircraft performance management, and an autothrottle are the primary additions to the previous capabilities of the SPZ-8000. Author

N91-12575# Beech Aircraft Corp., Wichita, KS.
DESIGN AND CERTIFICATION OF AIRCRAFT FOR THE HERF ENVIRONMENT c05
Jack Glecier and Joseph P. Cross *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 330-347 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

Certification authorities world-wide are in the process of amending regulations to add new standards which will provide requirements for the protection of aircraft flight critical functions from the effects of high energy radiated electromagnetic fields (HERF). In late 1989, the Federal Aviation Administration (FAA) imposed requirements on the Beech Model 2000 Starship airplane requiring qualification of the installed equipment for operation in HERF conditions. Field levels imposed for aircraft certification to the HERF threat require hardening aircraft electronic systems to a level two orders of magnitude above today's typical equipment qualification levels. Two large design challenges are thereby imposed: (1) hardening equipment requires extraordinary measures to insure performance; and (2) conventional test methods and test equipment used for qualification are not capable of adequately assessing performance at the high field levels. HERF design considerations and solutions relative to the above subjects and the experience gained by Beech Aircraft during the Starship and subsequent development programs in evaluating flight critical system performance of aircraft certification in the HERF environment are discussed. Author

N91-12576# Federal Aviation Administration, Atlantic City, NJ.
THE FAA TECHNICAL CENTER'S AVIONICS DATA LINK INITIATIVE c06
Albert J. Rehmann *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 348-357 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

Weather and air traffic control (ATC) services have been developed at the Federal Aviation Administration (FAA) Technical Center to be delivered to aircraft via data link. The six weather and three air traffic control (ATC) services were designed to meet the needs of pilots and air traffic controllers. To assess the suitability of data link services to both user groups, two mini studies and a full fidelity operational evaluation were conducted. In the mini studies, pilots were asked to view data link cockpit presentations depicted on a personal computer (PC) display. In the operational evaluation, four general aviation pilots flew a GAT II B cockpit simulator configurated as a Cessna 421. Four airline crews flew a B-727 cockpit simulator. Subjective and objective data were collected on pilot performance during the operational evaluation. Results showed that the pilots' interaction time with data link was comparable to the time spent in voice communications. Furthermore, thirteen errors/callbacks/repeats were logged in with voice communications while none were logged with data link. The Technical Center plans to continue the human factors research to broaden the pilot performance data base. Research will also continue to provide low cost solutions to expensive avionics. Author

N91-12577# Federal Aviation Administration, Atlantic City, NJ.
GENERAL AVIATION AND TCAS c04
Carl B. Jezierski *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 358-363 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

The amended Traffic Alert and Collision Avoidance System (TCAS) rule was published in the Federal Register on April 9, 1990. It requires TCAS-II equipage of all civil aircraft with more than 30 passenger seats operating in the United States by December 30, 1993. The same rule also requires turbine powered aircraft with 10 to 30 seats to be equipped with TCAS-I by February 9, 1995. Described here is the technical operation of the different types of TCAS and how General Aviation participates in the TCAS environment. Development efforts of a low cost airborne collision avoidance system are also addressed. Author

N91-12578# Computer Technology Associates, Inc., McKee City, NJ.
SUMMARY OF THE FAA LOW DATA RATE VOICE CODEC EVALUATION AND DEMONSTRATION PROGRAM c32
Markus R. Grable *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 364-372 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

The Federal Aviation Administration's (FAAs) low data rate voice coder/decoder (CODEC) evaluation and demonstration program is summarized. This program will assess the performance and operational characteristics of low data rate voice digitizing equipment in an aeronautical satellite link environment for air traffic control (ATC) applications. A concern of the FAA is to achieve acceptable voice performance for ATC in the most efficient manner. The FAA will recommend a low data rate voice CODEC standard for inclusion to Aeronautical Mobile Satellite Service (AMSS) voice communications based on the program results. The Phase II CODEC evaluation and results are focused upon. Author

N91-12579# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
SEMINAR ON THE STRUCTURE OF AERONAUTICAL R/D
May 1990 108 p Seminar held in Lisbon, Portugal, 31 May - 1 Jun. 1990; in Patras, Greece, 4-5 Jun. 1990; and in Ankara, Turkey, 7-8 Jun. 1990
(AGARD-R-782; ISBN-92-835-0564-6) Copyright Avail: NTIS HC/MF A06; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Background material and experiences in planning and execution of aeronautical research and developments obtained by the various American and European authors are covered. They served as a basis for a Seminar held in Greece, Portugal and Turkey which aimed at assisting the authorities in planning aeronautical research and development. Various aspects of national and international cooperation in aerospace are highlighted. For individual titles, see N91-12580 through N91-12586.

N91-12580# National Center for Advanced Technologies, Washington, DC.
THE PROSPECTS OF AERONAUTICS
J. M. Swihart *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 24 p (For primary document see N91-12579 04-01)
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When considering aeronautical research and development it

is useful to begin by reviewing the prospects of aeronautics for the next decades. As is clear from the other papers, the participation in any major development in aeronautics requires a sustained effort of many years and so major contributions are considered, nationally or internationally, which will come to fruition in the next century. The 20th century saw the development of aeronautics on a global scale. The question is asked if this development now has levelled off and if from now on only marginal improvements and utilization will take place. It is indicated that there will be tremendous challenges and opportunities in the coming decades. The essence of the 50th Wright Brothers Lecture, first given in St. Louis, Missouri, USA on 14 September 1987 is contained. The lecture concentrated on civil aeronautics, but of course many identical technical developments apply equally to military and civil aviation. In fact the history of aeronautical development shows that there is an intimate relationship between civil and military aeronautical developments. The developments since 1987, when the paper was written, suggest that the outlook for technical aeronautical developments has not become less and, in fact, the developments may far exceed the expectations of a few years ago. Author

N91-12581# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE PROBLEM OF RESEARCH IN LDDI (LESS DEVELOPED DEFENSE INDUSTRY) COUNTRIES
A. Auriol *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 7 p (For primary document see N91-12579 04-01)
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Topics addressed include: the need for applied research; existing baseline resources; cooperation with other countries; some characteristics of the aeronautical and armament industries; some characteristics of modern technology; and future needs (the choice of possible developments, and planning research). The appendices include the Estoril communique; and the NATO science program. Author

N91-12582# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AERONAUTICAL R/D IN SMALLER COUNTRIES
Jan A. vanderBliek *In its* Seminar on the Structure of Aeronautical R/D May 1990 15 p (For primary document see N91-12579 04-01)
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Aeronautics fulfills an important function in education (engineering sciences), industry, traffic and trade. It is quite often considered as a major factor in the economic future of a country, together with electronic computers, atomic energy (recently with more emphasis). This, combined with the necessity to maintain an effective air defense, makes it mandatory for industrially developing countries to evaluate carefully to what extent they want to invest in aeronautics and, more generally, in aerospace. The planning and organization of aeronautical research and development and its role in aeronautics in general are discussed. Special attention is given to the situation of smaller countries. The paper is to a large extent based on experiences gained in Canada, the USA and especially in the Netherlands. Although this experience may be only of limited direct use to industrially developing countries, it may assist in charting the course of those countries. Author

N91-12583# British Aerospace Public Ltd. Co., Hatfield (England).
DETERMINING TECHNOLOGY OBJECTIVES **c81**
J. B. Scott-Wilson *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 4 p (For primary document see N91-12579 04-01)
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Scientific research continues to offer an ever increasing number of technological possibilities capable of exploitation. Governments and Industrial concerns alike have to make decisions on which technologies to support. When broad defense needs or market objectives were determined the study method, developed by AGARD and its Aerospace Applications Studies Committee, provides an effective means of focusing technology objectives. The application of the study method to Project 2000, a broad technology forecast undertaken for the NATO Military Committee is described. Guidance is provided on how to set up similar studies. Author

N91-12584# Alabama Univ., Huntsville.
AERONAUTICAL COMPONENT RESEARCH **c81**
James J. Kramer *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 5 p (For primary document see N91-12579 04-01)
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The development of NACA to the present NASA is discussed. Details of the research planning process are reviewed. The planning and execution of a major research program, the Aircraft Energy Efficiency program, is reviewed and the various degrees of success are discussed. New areas of emphasis in component research include the use of computational analysis techniques on a broad range of topics and the continued emphasis on the environmental impact of aircraft operations. The historical role of NACA and NASA in aeronautics from the beginning in 1915 up to today has been and continues to be in component research. In aeronautics NASA does not apply technology to development or operation of its own systems as it does in space. Its only mission is to conduct research and develop technology for use by others. NACA/NASA aeronautical research is generally viewed as quite successful. Some reasons for its success were the favorable work environment created by management and the quality and flexibility of its research staff. Author

N91-12585# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PLANNING APPLIED RESEARCH IN FRANCE **c81**
A. Auriol *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 16 p (For primary document see N91-12579 04-01)
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The development of a new weapon system is a very expensive operation. The development process consists of fundamental research, prototype design; and operational testing of the prototype. The organization of the Ministry of Defense; features of armament and aeronautical research; structure of aeronautical industry and research; and the orientation and programming of applied research are outlined in order to understand the development process. B.G.

N91-12586# Messerschmitt-Boelkow-Blohm G.m.b.H., Brussels (Belgium).
INTERNATIONAL COOPERATION IN AERONAUTICAL RESEARCH AND DEVELOPMENT CARRIED OUT BY INTERNATIONAL ORGANISATIONS **c84**
Juergen H. Wild *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 27 p (For primary document see N91-12579 04-01)
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The following subjects are addressed: objectives and structures of cooperative programs; review of cooperative schemes in research and development; description of programs and projects; funding systems schemes for research and technology cooperation; and the specific situation concerning research technology and development in Portugal, Greece, and Turkey. B.G.

N91-12587# Institute for Defense Analyses, Alexandria, VA. Cost Analysis and Research Div.
TRENDS IN A SAMPLE OF DEFENSE AIRCRAFT CONTRACTORS' COSTS Final Report, Oct. 1989 - Aug. 1990
James D. McCullough and Stephen J. Balut Aug. 1990 23 p
(AD-A225663; AD-E501258; IDA-D-764; IDA/HQ-90-35426)
Avail: NTIS HC/MF A03 CSCL 05/3

This paper contains information on historical trends in direct and indirect costs for four defense aircraft contractors: General Dynamics-Fort Worth Division, Grumman Aerospace Corporation, McDonnell Aircraft Company, and Northrop Aircraft Company. The trends are presented for those four contractors in aggregate rather than individually. The paper concludes with a look at what these trends may mean in terms of future costs. GRA

N91-12588# Institute for Defense Analyses, Alexandria, VA.
ANALYSES OF A COPRODUCTION ACQUISITION STRATEGY FOR THE LIGHT HELICOPTER PROGRAM (LH) Final Report, Dec. 1988 - Apr. 1990
William J. E. Shafer, Barbara J. Junghans, Neang I. Om, Paul R. Palmer, Jr., and Joseph W. Stahl Apr. 1990 60 p
(Contract MDA903-89-C-0003)
(AD-A226109; AD-E501264; IDA-P-2385; IDA/HQ-90-35400)
Avail: NTIS HC/MF A04 CSCL 01/3

The purpose of this study was to assess the potential cost savings of using a coproduction versus a competition acquisition strategy for the U.S. Army's Light Helicopter (LH) program (formerly LHX). The Army's Baseline Cost Estimate (BCE) is examined and reproduced before adjustments are made based on changes in the methodology used by the Army. The analysis of costs covers all production costs and considers the time value of money, the production schedule, and sustainment costs. Based on their analysis, the authors conclude that coproduction would be the least-cost acquisition strategy. GRA

N91-12589* National Aeronautics and Space Administration, Washington, DC.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 257)
Oct. 1990 156 p
(NASA-SP-7037(257); NAS 1.21:7037(257)) Avail: NTIS HC A08; NTIS standing order as PB90-914100, $11.50 domestic, $23.00 foreign CSCL 01A

This bibliography lists 560 reports, articles, and other documents introduced into the NASA scientific and technical information system in September 1990. Subject coverage includes: design, construction and testing of aircraft and aircraft engines; aircraft components, equipment and systems; ground support systems; and theoretical and applied aspects of aerodynamics and general fluid dynamics. Author

N91-12590*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PATHFINDER AUTONOMOUS RENDEZVOUS AND DOCKING PROJECT Annual Report, 1989
Stephen Lamkin, ed. and Wayne McCandless, ed. (Lockheed Engineering and Sciences Co., Houston, TX.) Aug. 1990 146 p
(NASA-TM-102163; S-607; NAS 1.15:102163) Avail: NTIS HC/MF A07 CSCL 01B

Capabilities are being developed and demonstrated to support manned and unmanned vehicle operations in lunar and planetary orbits. In this initial phase, primary emphasis is placed on definition of the system requirements for candidate Pathfinder mission applications and correlation of these system-level requirements with specific requirements. The FY-89 activities detailed are best characterized as foundation building. The majority of the efforts were dedicated to assessing the current state of the art, identifying desired elaborations and expansions to this level of development and charting a course that will realize the desired objectives in the future. Efforts are detailed across all work packages in developing those requirements and tools needed to test, refine, and validate basic autonomous rendezvous and docking elements. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N91-12591# National Aerospace Lab., Tokyo (Japan).
PROCEEDINGS OF THE 6TH NAL SYMPOSIUM ON AIRCRAFT COMPUTATIONAL AERODYNAMICS
Dec. 1988 251 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 16-17 Jun. 1988
(DE89-910195; NAL-SP-9; ISSN-0289-260X; JTN-90-80118)
Avail: NTIS HC/MF A12

The following topics were discussed: computational fluid dynamics, numerical flow visualization, numerical analysis, computerized simulation, difference schemes, the total variation diminishing, the implicit method, grid generation, the Navier-Stokes equation, computerized simulation, three dimensional flow, high Reynolds number flow, viscous flow, shock waves, the finite element method, the finite volume method, the alternating direction implicit method, transonic flow, supersonic flow, hypersonic flow, and airfoils. For individual titles, see N91-12592 through N91-12628.

N91-12592# Washington Univ., Seattle. Dept. of Aerodynamics and Astronautics.
RECENT HYPERSONIC NAVIER/STOKES CALCULATIONS
Hideo Yoshihara *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 1-8 Prepared in cooperation with ONR, Tokyo, Japan (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Some recent Reynolds-averaged Navier/Stokes (N/S) calculations at hypersonic Mach numbers are described. The methods used include a Parabolized N/S (PNS) method and a thin layer N/S method (ARC3D). PNS examples include the flow over a cone where test/theory comparisons are made to assess the results. The second example is for a generic hypersonic wing/fuselage configuration having realistic configuration features at M=25 using both PNS and ARC3D codes. Concluding statements then cover some outstanding problems that remain for the calculation of hypersonic flows. NASDA

N91-12593# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
A NUMERICAL CALCULATION METHOD FOR THREE-DIMENSIONAL FLOWS IN THE DUMP DIFFUSER OF GAS TURBINE COMBUSTOR
Yasunori Ando, Masafumi Kawai, Yukinori Sato, and Hidemi Toh *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 9-14 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A finite volume method for the solution of three-dimensional incompressible steady Navier-Stokes equations based on a general curvilinear coordinate system was employed to study characteristics of turbulent flow in the dump diffuser of a gas turbine combustor. The standard kappa-epsilon turbulence model is used to characterize the effect of turbulence. In order to achieve a saving in central processing unit time for calculation, calculations were performed by using the vector computer architecture of the supercomputer FACOM VP-50. This method is applied to prediction of turbulent flow in a three-dimensional dump diffuser with and without the fuel nozzle. The calculated results are compared with corresponding experimental data obtained in this work. General

features of the flow pattern are adequately predicted, although discrepancies in detail seem to indicate deficiencies in the turbulence model used in present study. NASDA

N91-12594# Tokyo Metropolitan Univ. (Japan). Coll. of Aeronautical Engineering.
NUMERICAL SIMULATION OF HYDROGEN-OXYGEN CHEMICAL REACTIONS IN ANNULAR COMBUSTION CHAMBER **c25**
Shizui Watanabe and Shuuji Fujii *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 15-19 In JAPANESE (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The method of numerical simulation for combustion phenomena is reviewed. The method was for combustion with the diffusion of oxygen and hydrogen in an anaxisymmetric flow field. The axisymmetric, viscous and compressible governing equations were used and the conservation equation of chemical species based on Fick's law was adopted. The method of Donnar-cell type was used for the spatial difference and an implicit scheme was used for time. The flow field was obtained with a Newton-Raphson iteration of the energy equation. Chemical reactions were analyzed at the level of elementary reactions. Specific heat of each species and transport coefficients were thought to be functions of temperature. Here, the boundary condition was improved to simulate the continuous inflow and outflow and the computational method for diffusion phenomena was improved to simulate the mutual diffusion among each chemical species. An example of the numerical simulation that analyzes the hydrogen-oxygen chemical reactions in an annular combustion chamber is presented. NASDA

N91-12595# Nissan Motor Co. Ltd., Tokyo (Japan).
NUMERICAL SIMULATIONS OF THE FLOW FIELD IN A SCRAM JET ENGINE COMBUSTOR **c07**
Kenichi Hirai *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 21-26 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The flow fields over rearward facing steps are investigated numerically for the purpose of qualitative understanding of the fuel injection system in the SCRAM jet engine combustor. The results show that the location of transverse injection in relation to the step has significant influence on the size of recirculation zone. Author (NASDA)

N91-12596# National Aerospace Lab., Tokyo (Japan).
NUMERICAL CALCULATION OF CHEMICALLY REACTING COMPRESSIBLE FLOW
Tomiko Ishiguro, Satoru Ogawa, and Yasuhiro Wada *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 27-35 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A summary of a solver-code which is being developed for the purpose of numerically analyzing chemically reacting compressible flows is presented. The code solves the two or three-dimensional Reynolds time average complete Navier-Stokes equations including species transport equations, and has two strong points. The first point is that the system of governing equations for the flow computation contains a total mass conservation equation and transport equations of all species taking account of total mass conservation and impartial numerical treatment of every chemical species. Therefore, the correction of mass ratios of all species is made so that the summation of them is equal to one after every time step integration. The second point is that the total variation diminishing (TVD) difference scheme is used in order to capture strong discontinuous surfaces clearly and efficiently which are apt to appear in supersonic flow fields. Applying this solver, shock-induced chemically reacting flows and flow fields for the case of transverse sonic injection of H sub 2 fuel into a supersonic airstream are analyzed numerically. Author (NASDA)

N91-12597# National Aerospace Lab., Kakuda (Japan).
NUMERICAL ANALYSIS OF THE FLOW IN ROTATING STRAIGHT PIPE **c34**
Hiroshi Ishigaki and Munekazu Mochizuki *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 37-42 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Parabolized Navier-Stokes Computations are reported for laminar flow in a circular pipe rotating about an axis perpendicular to that of the pipe. The results are compared with the experimental data by Ito and Nanbu in regard to the friction factor, velocity profile in the symmetry plane, and wall pressure distribution. Author (NASDA)

N91-12598# Tsukuba Univ. (Japan).
THE ACCURACY OF DIRECT NUMERICAL SIMULATION OF WALL TURBULENT FLOW AND THE NUMERICAL PREDICTION ON THE EFFECT OF DRAG REDUCING DEVICES **c34**
Tatsuya Ohgishi, Shunichi Tsuge, and Satoru Ogawa (National Aerospace Lab., Tokyo, Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 43-48 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The region of validity in terms of the Reynolds number of direct simulation of turbulent flows is reexamined for two-dimensional channel flows. The computed value of the skin friction based on the third order upwind scheme with three times ten to the fifth power mesh points starts to deviate from existing data when the Reynolds number exceeds two times ten to the fourth power. Within the validation limit of the computational method, an attempt is made to explore the mechanism of drag reduction due to a piblet-like arrays features. The computed equivorticity contours show the effect of lifting and fragmentation of the longitudinal vortices caused by the protuberance within the sublayer. NASDA

N91-12599# National Aerospace Lab., Tokyo (Japan).
SIMULATIONS FOR A PARALLEL COMPUTER **c61**
Koichi Harada *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 49-54 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A simulation program for a parallel computer configured with 128 times 256 processing elements was implemented on the numerical simulator in the National Aerospace Laboratory. It simulates memory access and register operations at the clock level and generates time charts along with operation results. Described here is the evaluation method for the parallel computer using a basic function subroutine. The instruction set and network between the memories is examined, as well as the processing elements. Author (NASDA)

N91-12600# Ship Research Inst., Tokyo (Japan).
THREE-D GRID GENERATION USING THE GEOMETRICAL METHOD **c64**
Yoshiaki Kodama *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 55-60 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A three-D grid was generated using a geometrical method in which an initial grid was modified iteratively according to several geometrical requirements. The requirements were orthogonality, smoothing, clustering, and minimum spacing. They can be used either separately or in combination. In case they are used in combination, the modified grid is obtained as a compromise among

conflicting requirements. An important tool which supports the above four algorithms in grid generation is re-clustering. Based on an initial grid distribution, it is used for re-distributing points according to a new clustering requirement, and at the same time, for changing the number of points. The requirements can also be used for tuning an existing grid. It can be used either globally or locally. An example of tuning a two-D grid around a turbine blade is shown. The third use of the method is to quantify the grid quality. An example of a three-D grid is shown, where the orthogonality requirement was used to measure deviation from orthogonality, and the deviation was plotted as three-D contours. Further improvement is needed in the way requirements are combined to update the grid. Author (NASDA)

N91-12601# Nissan Motor Co. Ltd., Tokyo (Japan).
VISUALIZATION OF THE COMPUTED UNSTEADY FLOW IN THREE DIMENSIONS **c34**
Katsuro Fujitani and Ryutaro Himeno *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 61-65 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Three-dimensional unsteady flow of a viscous incompressible fluid is calculated by using a finite-difference method and visualized by a graphic workstation. A grid system around an automobile has a multi-grid structure and is generated by a trans-finite-interpolation method. The number of grid points is 112 times 73 times 56 and the Reynolds number based on the length of the automobile is 5,000,000. The calculation of a flow field is done on Fujitsu VP200 and computational time is about 20 hours. Computed flow fields of 200 timesteps are stored in magnetic tapes. Using them, streak-lines are calculated on a mini-supercomputer C-1 and even then visualized on graphic workstation IRIS 4D. A motion film is taken the IRIS screen frame by frame using a computer-controlled VTR (video taperecorder) system. A longitudinal vortex on the side-window is almost steady. However, the other vortices, such as a horse-shoe one in front of the front windshield and vortices on the rear-window, show periodical changes and are shed one by one. It is found that a motion film makes the unsteady three-dimensional flow understandable. The amount of the data used in the three-dimensional unsteady calculation is so huge that shortening of data is necessary. Author (NASDA)

N91-12602# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
NUMERICAL SIMULATION OF AERODYNAMIC EFFECTS OF THE REAR-SPOILER ON AN AUTOMOBILE
Kazuhiro Satoh, Kunio Kuwahara, Koichi Masuda, and Masahiro Suzuki (Tokyo Univ., Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 67-76 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

In order to shorten a period of development of automobiles and encourage new technology, the necessity for numerical simulation of flow around an automobile has been rapidly increasing in recent years. But it was not easy to calculate the flow around an automobile with a separated flow, because of unstability in calculation. The effects of the rear-spoiler on a two-dimensional model of an automobile were simulated using the third-order upwind differencing scheme. The computational results show good agreement with results of wind tunnel tests. It is shown that the present method is effective as a design tool, in predicting flow around an automobile with a separated flow. Author (NASDA)

N91-12603# Tohoku Univ., Sendai (Japan). Dept. of Mechanical Engineering.
AN IMPLICIT TIME-MARCHING METHOD FOR THE THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS OF CONTRAVARIANT VELOCITY COMPONENTS **c34**
Hisaaki Daiguji and Satoru Yamamoto *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 77-83 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The implicit time-marching finite-difference method for solving the three-dimensional compressible Euler equations developed by the authors is extended to the Navier-Stokes equations. The distinctive features of this method are to make use of momentum equations of contravariant velocities instead of physical boundaries, and to be able to treat the periodic boundary condition for the three-dimensional impeller flow easily. These equations can be solved by using the same techniques as the Euler equations, such as the delta-form approximate factorization, diagonalization and upstreaming. In addition to them, a simplified total variation diminishing scheme by the authors is applied to the present method in order to capture strong shock waves clearly. Finally, the computed results of the three-dimensional flow through a transonic compressor rotor with tip clearance are shown. Author (NASDA)

N91-12604# Osaka Univ. (Japan). Dept. of Aeronautical Engineering.
COMPUTATIONS OF THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS BY USING A PRISMATIC MESH **c34**
Kazuhiro Nakahashi *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 85-91 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A numerical scheme using a prismatic element is developed for three-dimensional, compressible Navier-Stokes equations. With prismatic elements, a body surface is covered by an unstructured triangular mesh which gives the geometrical flexibility. In the direction normal to the body surface, the grid is structured so that an efficient computational scheme using the implicit residual averaging and the multigrid technique can be developed. This directionally-structured grid also enables us to implement the thin-layer approximation and the Baldwin-Lomax algebraic turbulence mode easily. For general flow fields, a combination of several grids including prism, tetrahedron, and hexagon, is utilized to describe the complex field. Author (NASDA)

N91-12605# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
AN IMPLICIT SCHEME FOR UNSTEADY COMPRESSIBLE NAVIER-STOKES EQUATIONS **c34**
Kenichi Matsuno *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 93-96 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

In this paper a time accurate scheme for unsteady Navier-Stokes equations is presented. This scheme employs, as unknowns, quantities of order of square of time spacing, thus making a delta square-form of which the right hand side is a numerical approximation of unsteady governing equations. This algorithm makes a scheme especially suitable for accurate simulations. A shock tube flow is calculated as an example. The flow is assumed laminar, and shock wave-boundary layer interaction is simulated. Author (NASDA)

N91-12606# National Aerospace Lab., Tokyo (Japan).
DIFFERENCE SCHEME OF BOLTZMANN-GODUNOV TYPE
Toshiyuki Iwamiya, Tadayasu Takahashi, and Hideaki Aiso *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 97-102 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Here, the Boltzmann approach and the Godunov procedure are combined to give rise to a new way of constructing a variety of difference schemes for hyperbolic conservation laws (Boltzmann-Godunov type difference schemes). Upwindness is naturally introduced in this formulation. It is shown that most of the upwind schemes proposed so far can be formally interpreted

as Boltzmann-Godunov type difference schemes.
Author (NASDA)

N91-12607# National Aerospace Lab., Tokyo (Japan).
A COMPARATIVE STUDY ON TV-STABLE SCHEMES c34
Takayuki Aki *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 103-112 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Three representative schemes among the total variation (TV) stable family were tested for comparing smoothness of solution, resolution power of fluid dynamic discontinuities, and implementation cost. A total variation diminishing (TVD) of Harten-Yee type, its total variation bounded (TVB) modification by Shu's method, and essential non-oscillatory (ENO) proposed by Harten-Osher were chosen, and use was made with discretization at the second order. The problem tested for space one-dimension was Sod's one and that for two-dimension shock propagation around a 90 degree bend in a channel. The tests had been conducted under the same computational conditions. Although all the schemes tested showed almost equal resolution for shocks, the ENO scheme provided the most smooth solution across shocks. The TVD scheme captured an instability in slip surface associated with Mach reflection. Implementation cost increased in order of TVD, TVB, and ENO. The cost increment of ENO to TVD was less than ten percent. Author (NASDA)

N91-12608# National Aerospace Lab., Tokyo (Japan).
A NEW CLASS OF TVD SCHEMES AND WALL BOUNDARY CONDITION c34
Yasuhiro Wada and Kiyoshi Kumagai (Tokyo Noko Univ., Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 113-120 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Recently, various total variation diminishing (TVD) schemes have been proposed and have achieved great success in flow computation. Here, two kinds of numerical method related to these modern shock-capturing schemes are proposed. First proposed are new TVD schemes with wide high-accuracy regions. Sample calculations show that these schemes have the ability of retaining the second-order accuracy near critical points such as shock waves. The second proposed method is a simple wall boundary condition. This is constructed by modelling the numerical fluxes about an imaginary control volume on wall boundary. Hypersonic computations show the accuracy and robustness of this condition. Author (NASDA)

N91-12609# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
ON A NEW DIFFERENCE SCHEME-ATVD2 c34
Satoru Ogawa, Tomiko Ishiguro, Yasuhiro Wada, and Yoko Takakura (Fujitsu Ltd., Tokyo, Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 121-125 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A new difference scheme is proposed which is constructed by applying the modified flux method proposed by Harten for the second order accuracy total variation diminishing (TVD2) second-order accuracy uniformly non oscillatory (UNO2) scheme. The numerical experiment of the ONERA-M6 wing test case shows the solutions of the proposed scheme without artificial compression. The parameters almost coincide with those of the Harten-Yee TVD scheme and the Chakravarthy-Osher TVD scheme with a maximum value of the artificial compression parameter. This fact shows that the proposed scheme is more accurate than other TVD schemes in multi-dimensional problems. It is also shown that the dependence of solutions on the artificial compression parameter is little in comparison to previous TVD schemes.
Author (NASDA)

N91-12610# Kawasaki Heavy Industries Ltd., Kobe (Japan).
THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING Report No. 6 c34
Takuji Kishimoto and Takashi Uchida *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 127-132 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Numerical analyses by solving Euler/Navier-Stokes Equations has been used in practical aeronautical engineerings. Here, the results of two dimensional Navier-Stokes analyses of a multiple slotted flap, and a three dimensional wing design problem using Euler analyses are shown. Author (NASDA)

N91-12611# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
NAVIER-STOKES SIMULATION OF TRANSONIC FLOW AROUND VENTILATED AIRFOILS
Keisuke Kamo, Yasuhiro Tani, and Kanichi Amano (Japan Aircraft Development Corp., Tokyo.) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 133-140 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A ventilated airfoil, which has porous areas or slits on its surface to generate passive ventilation, is expected to improve the lift-to-drag ratio in the transonic flow region. The flow characteristics of ventilated airfoils are simulated numerically using an improved two-dimensional compressible Navier-Stokes analysis code with the boundary condition modified for ventilation. Author (NASDA)

N91-12612# Mitsubishi Heavy-Industries Ltd., Tokyo (Japan).
COMPARISON WITH COMPUTATION USING PANEL METHOD AND WIND TUNNEL TEST AROUND TRANSONIC COMPLETE AIRCRAFT
Takeshi Kaiden, Junichi Miyakawa, Mitsunori Yanagisawa, and Kanichi Amano (Japan Aircraft Development Corp., Tokyo.) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 141-149 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The rapid progress of computational aerodynamics enables us to analyze airflow with viscous calculation instead of with an inviscid one. In two-dimensional application, the effectiveness in comparison with wind tunnel testing has already been validated and put into a practical stage. In three-dimensional applications, the wing-body configuration has been done. Presented here is a discussion of the panel method concerned with the analysis of the complete aircraft, including the calculation of the string interference, which is indispensable to wind tunnel testing. Results indicate that the panel method is valid in the subsonic region and that the sting makes up wash flow. Author (NASDA)

N91-12613# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
CALCULATION OF HIGH SPEED FLOW ABOUT WINGED BODY
Michiru Yasuhara, Yoshiaki Nakamura, and Shinji Inagaki *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 151-158 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The objective of the present study is to numerically calculate the flow about the fundamental configuration for a flying vehicle in supersonic and hypersonic regimes. Two kinds of body configurations were chosen: a hemisphere-cylinder and a shuttle-like body. In the present study three numerical schemes are employed to compare each result: the Beam-Warming method, the Yee-Harten total variation diminishing (TVD) method and the MacCormack TVD method. Furthermore, those results are compared with an experiment which was conducted by the shock tunnel at Nagoya University at M=eight. Reasonable agreement

was obtained between them for the location of bow shock waves which validate the present simulation. Author (NASDA)

N91-12614# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
UPWIND DIFFERENCING FOR VISCOUS FLOW COMPUTATIONS **c34**
Kozo Fujii, Susumu Takanashi, and Kisa Matsushima (Fujitsu Ltd., Tokyo, Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 159-162 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

High-resolution upwind differencing has become a popular feature of recently-developed Euler methods for compressible inviscid flow simulations. This feature was straightforwardly extended for the evaluation of convective terms of the Navier-Stokes equations. Recent study of total variation diminishing (TVD) type high-resolution upwind schemes proved that dissipation-like terms introduced by these upwind schemes such as Roe's flux difference splitting automatically become small in the viscous layers. Here, numerical computations using this Roe's upwind scheme with MUSCL interpolation are conducted, and the results are compared with the typical central differencing results. The computed results indicate that the present upwind differencing shows better resolution than the central differencing in both inviscid region and viscous region. Author (NASDA)

N91-12615# National Aerospace Lab., Tokyo (Japan).
NAVIER-STOKES SIMULATIONS OF A WINGED VEHICLE USING UPWIND SCHEME
Masakazu Tachibana and Susumu Takanashi *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 163-165 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Supersonic flow about a winged vehicle is investigated. An upwind scheme based on a total variation diminishing (TVD) formulation is used to solve the thin layer Navier-Stokes equations. The result for alpha=20 deg shows three kinds of separation line on the upper surface. Author (NASDA)

N91-12616# Fujitsu Ltd., Tokyo (Japan).
NUMERICAL SIMULATIONS OF AERODYNAMICAL CONTRIBUTION OF FLOWS ABOUT A SPACE-PLANE Report No. 2
Kisa Matsushima, Susumu Takanashi, and Kozo Fujii (Tokyo Univ., Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 167-174 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The flows about a Space-Plane have been numerically simulated by solving the Reynolds averaged Navier-Stokes equations. The simulations can catch some aerodynamic effects due to the height of the angle of attack, the speed of the free stream or the shape of the space-plane. The higher the angle of attack is, the more complicated are the vortical phenomena and the interaction between body and wing. The difference between the situation of shock waves or leading edge separations according to the difference of free stream Mach number can be represented. As for the total life, the total drag and the total pitching moment, computational results show fairly good agreement with experiments. More research must be done to judge how precisely numerical simulations explain the physical phenomena which really happen in the atmosphere. Author (NASDA)

N91-12617# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF HYPERSONIC FLOW AROUND A SPACE PLANE
Yukimitsu Yamamoto and Shin Kubo (Total System, Inc., Tokyo, Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 175-181 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Thomas and Van Leer's flux-split upwind total variation diminishing (TVD) scheme was applied to the hypersonic flow around a space plane proposed by the National Aerospace Laboratory (NAL). Thin-layer Navier-Stokes equations in a finite volume formulation are solved by using an implicit approximately factored alternating direction implicit (ADI) algorithm. Numerical computations are performed for the conditions of Mach number 7.0 and Reynolds number 4.4 times ten to the 6th power at angles of attack up 50 degrees. Numerical results are compared with experimental data obtained from the hypersonic wind tunnel tests at NAL. Through these comparisons, it is demonstrated that the present TVD Navier-Stokes code has excellent capabilities for evaluating total aerodynamic performance and the severe aerodynamic heating, which are of great significance in the design of a space plane configuration. In the present analysis, a modified Yee-Harten's TVD scheme is developed and applied. Numerical calculations were carried out by using these two schemes for M sub infinity = 10.0 at alpha = 0 deg, and almost the same pressure contours are obtained. Author (NASDA)

N91-12618# National Aerospace Lab., Tokyo (Japan).
RAREFIED GAS NUMERICAL WIND TUNNEL Report No. 4
Katsuhisa Koura, Kinuyo Nakamura, and Toshiyuki Shimoji (Facom Hitac Co. Ltd., Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 183-186 (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The rarefied gas numerical wind tunnel (RGNWT) for simulation of rarefied gas flows around three-dimensional space vehicles is under construction. The RGNWT consists of the universal code described using the null-collision (NC) direct-simulation Monte Carlo Method and the software for the grid generation and graphic display. In order to ascertain the feasibility of the RGNWT, quantitative comparisons between the NC and time-counter (TC) direct-simulation Monte Carlo Methods are made for the shock wave structure and leading-edge flow. It is shown in the leading-edge flow that the NC method is stronger for the small number of simulation molecules than the TC method; the lower limit of the number of simulation molecules for the NC method is less than one third of that for the TC method. The computation time for the NC method is comparable to that for the TC method for the same number of simulation molecules. Author (NASDA)

N91-12619# Kyoto Univ. (Japan). Dept. of Aeronautics.
NUMERICAL ANALYSIS OF GAS-PARTICLE TWO-PHASE FLOWS **c34**
Ryuji Ishii, Yoshikuni Umeda, and Masatoshi Uhi *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 187-192 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A numerical analysis of axisymmetric gas-particle two phase flows is described. Under-expanded supersonic free-jet flows and supersonic flows around a truncated cylinder of gas-particle mixtures are solved numerically on the Fujitsu VP-200 supercomputer. Although the gas phase is treated as a continuum medium, the particle phase is done partly as a discrete one. The particle cloud is divided into a large number of small ring clouds. In each cloud, particles are approximated to have nearly the same velocity and temperature. The particle flowfield is obtained by following these individual ring clouds separately in the whole computational domain. In estimating the time rates of momentum and heat transfers from the particle phase to the gas one, the contributions from these ring clouds are averaged over some volume whose characteristic length is sufficiently small compared with the characteristic length of the flowfield but sufficiently large compared with that of the ring clouds. The numerical results have shown that the flow characteristics of the gas-particle mixtures are very much different from those of the dust-free gas.
Author (NASDA)

N91-12620# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
INTERACTION BETWEEN A SPHERICAL JET AND A FLOW **c34**
Takuya Matsuda, Yuzo Fujimoto, Eiji Shima, and Keisuke Sawada (Kawasaki Heavy Industries Ltd., Kobe, Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 193-198 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Numerical simulations of hydrodynamic interaction between a uniform incident flow and a spherical supersonic wind from an astronomical object are performed. The flow is assumed to be axisymmetric, adiabatic and inviscid. A bow shock, a contact surface, an inner shock with a Mach disc and a slip surface are observed. It is found that the contact surface and the slip surface are Kelvin-Helmholtz unstable. Author (NASDA)

N91-12621# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
NUMERICAL ANALYSIS OF HIGH VELOCITY FLOW FIELD AROUND THE BLUFF BODY **c34**
Yukinori Sato, Hidemi Toh, Yasunori Ando, and Masafumi Kawai *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 199-204 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A finite-volume numerical analysis method for the solution of three-dimensional incompressible steady Navier-Stokes equations in a general curvilinear coordinate system is presented. The main solution algorithm of the method is an extension of SIMPLE algorithm to present general curvilinear coordinate formulation. The standard k-epsilon two equations turbulence model is used for the closure of the Reynolds equation. Numerical analysis are compared with experimental results for the flow field around the U-shaped gutter in a diffuser with fairly good agreement. This method is applied to the calculation of turbulent three-dimensional flows around the bluff body to obtain the velocity and temperature flow field. A feature of the velocity and temperature field around the bluff body was clarified. Author (NASDA)

N91-12622# National Aerospace Lab., Tokyo (Japan). Structural Mechanics Div.
NUMERICAL SIMULATION OF UNSTEADY AERODYNAMICS AROUND AN OSCILLATING WING IN ELASTIC MODES
Jiro Nakamichi *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 205-214 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Unsteady Navier-Stokes calculations around airfoil/wing configurations are demonstrated. Two D (two dimensional) transonic flutter simulations are performed about a NACA 64A010 airfoil using not only a diagonal form of Beam-Warming scheme but also a non-diagonal one. The effects of time accuracy of the algorithms on the flutter boundaries are checked by comparing two results. Three D (three dimensional) unsteady computation around an oscillating wing in elastic motion are carried out and obtained results are compared with experimental data. It is found that the diagonal form of Beam-Warming scheme is efficient for predicting the flutter boundaries of airfoils in cases where the flow is not separated. It is also demonstrated that the present three D code gives results in agreements with experimental data. It can be used for three D flutter simulation programs in a similar manner to two D cases. Author (NASDA)

N91-12623# Fujitsu Ltd., Tokyo (Japan).
ON THE COMPUTATION OF VISCOUS FLOWS AROUND A THREE-DIMENSIONAL WING
Yoko Takakura, Satoru Ogawa, and Tomiko Ishiguro (National Aerospace Lab., Tokyo, Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 215-221 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

The applicability of our modified total variation diminishing (TVD) schemes (Harten-Yee and Chakavarthy Osher numerical fluxes) to the viscous flow problems is examined. At the same time, the improvements of the left-hand-side operators to reach steady states and the turbulent model of large eddy simulation (LES) are presented. The computation of viscous flows around the ONERA-M6 wing indicate that the improved left-hand-side operators have a better convergence rate than the original one, that the improved turbulent model of LES works well even in the high attack-angle problem, and that these TVD schemes are applicable to the viscous flow problems. Author (NASDA)

N91-12624# Tottori Univ. (Japan). Dept. of Applied Mathematics and Physics.
NUMERICAL SIMULATION OF FLOW AROUND THE AIRCRAFT DESIGNED TO UTILIZE GROUND EFFECT
T. Kawamura and Shozo Kubo *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 223-227 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Flow around an aircraft spatially designed to take advantage of ground effect effectively is studied by using the incompressible Navier-Stokes equations. A third-order upwind difference scheme is used to solve the equations. Calculations are carried out under many conditions, i.e., the distance from the body to the ground, the angle of attack and the Reynolds number, etc. are changed systematically in order to investigate these effects on the flow field and forces acting on the body. Author (NASDA)

N91-12625# National Aerospace Lab., Tokyo (Japan).
VERIFICATION OF 2D-VISCOUS FLOW SIMULATION CODES USING AIRFOIL WITH VERY SMALL LEADING EDGE RADIUS
Masahiro Fukuda, Kazuhiro Nakahashi, Naoki Hirose, Nobuhiro Kawai, and Eiji Kikuno (Sumitomo Precision Products Co. Ltd., Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 229-234 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

In recent years, numerical simulation methods based on viscous equations have been widely applied to aerodynamic research and development in airfoils, wings, fuselages, etc. It has proved powerful, and the application of this method to propeller blades research and development, especially for the ATP (advanced turboprop)-blades, is natural. While many experiences with two-dimensional viscous simulation for thick airfoils are accumulated, experience with thin airfoils with very sharp leading edges has been scant. The verification of two-dimensional viscous simulation codes, NSFOIL and NS2D applied to one of those airfoils, NACA 16-204 airfoil which was tested in the two-dimensional wind tunnel at the National Aerospace Laboratory last year, is the main object of the present report. Mach number sweeps at low angles of attack and angle of attack sweeps at $M=0.6$ and 0.85 were made. The comparison of the computed aerodynamic characteristics with the wind tunnel data assure us that the method is useful in this field, although some improvements in the codes are to be desired. Author (NASDA)

N91-12626# Tokyo Univ. (Japan).
THREE-DIMENSIONAL NAVIER-STOKES SIMULATION OF FLOW AROUND ATP
Yuichi Matsuo, Chuichi Arakawa, Shigeru Saito, and Hiroshi Kobayashi (National Aerospace Lab., Tokyo, Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 235-241 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Viscous transonic rotational flows around a single rotation advanced turboprop (ATP) at cruise conditions were simulated

using three-dimensional Navier-Stokes equations. An implicit finite difference method based on a total variation diminishing (TVD) formulation and a Baldwin-Lomax model of turbulence were used for the solution procedure. The numerical results were successful in capturing viscous flow features such as shock boundary layer interaction and boundary layer separation. The predicted aerodynamic performances showed good agreement with experimental data. Author (NASDA)

N91-12627# Mitsubishi Heavy-Industries Ltd., Tokyo (Japan).
NUMERICAL SIMULATIONS OF FLOW AROUND ATP ENGINE
Masahiro Nakao and Junichi Miyakawa *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 243-248 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

Flow fields around the advanced turboprop (ATP) engine with counter-rotating propellers are simulated numerically by solving three-dimensional unsteady Euler equations. The numerical method is implicit approximate factorization developed by Beam and Warming. The calculation model is for an unducted fan style engine with eight times eight SR-3 propellers. The distribution of pressure on the blade surfaces, the propeller efficiencies, and the velocity vectors downstream of propellers are obtained. The relation of propeller efficiencies and velocity vectors downstream of rear propellers shows the features of counter-rotating propellers.
Author (NASDA)

N91-12628# National Aerospace Lab., Tokyo (Japan).
DESIGN OF ULTRA HIGH BYPASS FAN WITH NUMERICAL SOLUTION OF NAVIER-STOKES EQUATIONS c07
Osamu Nozaki, Yoshio Saito, Atsuhiro Tamura, and Kazuhiro Nakahashi (Osaka Univ., Suita, Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 249-255 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

A hardware model of an ultra high bypass fan blade was designed as a result of a numerical simulation based on Navier-Stokes (NS) equations. In the initial design, a double circular arc blade configuration was specified by the streamline curvature method. In a subsequent modification of the blade shape, the detailed flow fields around the blade were solved and visualized with a combination of NS code and a three dimensional graphic display unit. Finally, the optimum configuration of the blade was obtained. The purpose of this research is to propose a new design technique for the practical design of fluid machines by connecting NS codes and numerical visualization techniques.
Author (NASDA)

N91-12629*# Old Dominion Univ., Norfolk, VA. Dept. of Mathematics and Statistics.
WAVE-INTERACTIONS IN SUPERSONIC AND HYPERSONIC FLOWS Final Report, period ending 30 Sep. 1989
William D. Lakin Oct. 1990 7 p
(Grant NAG1-773)
(NASA-CR-181054; NAS 1.26:181054) Avail: NTIS HC/MF A02 CSCL 01A

Work completed under the current grant comprises the start of a theoretical and computational attack on the subharmonic route to secondary instabilities in compressible flows. The total flow field in this problem is made up of the following components: (1) a steady streamwise mean boundary layer flow which depends only on the normal space component y; (2) a two-dimensional time dependent T-S wave which moves with wavespeed c and has no spanwise dependence; and (3) a fully three-dimensional, time dependent T-S wave whose streamwise wavenumber is half of the streamwise wavenumber associated with the two-dimensional T-S wave in b. If a frame of reference is adopted which moves with the wavespeed c of the 2-D T-S wave, the time dependence of this portion of the flow can be eliminated. The effective steady mean flow in this problem is now the sum of the original parallel steady mean flow and the initial 2-D T-S instability. Dependence on the streamwise coordinate x in this mean flow can be extracted by assuming normal mode expansions involving complex exponentials and the streamwise wavenumber a. However, it is important to note that, because this is a wave-wave interaction problem, unlike the usual linear instability case, both the complex exponential, and its complex conjugate, must be retained in describing the 2-D T-S wave. The role of the perturbation to the steady mean flow is now played by the 3-D time dependent T-S wave. In treating this wave, normal modes in the streamwise and spanwise directions and time may be used. Consistent with the subharmonic nature of this transition route, the streamwise wavenumber is a/2, and complex conjugates of the complex exponential must be employed. This is not the case with the modes giving z and t dependence with wavespeed o and spanwise wavenumber B as the effective mean flow quantities are independent of z and their time dependence is accounted for by the moving frame of reference. Consequently, the wave-wave interaction which will produce mean flow modification occurs only through the streamwise exponentials. Author

N91-12630 Arizona Univ., Tucson.
NUMERICAL INVESTIGATION OF LAMINAR-TURBULENT TRANSITION IN A FLAT PLATE WAKE Ph.D. Thesis
David Ira Dratler 1990 278 p
Avail: Univ. Microfilms Order No. DA9022103

Numerical simulations, based on a spatial model are performed. Navier-Stokes equations are used in a vorticity-velocity form and are solved using a combination of finite-difference and spectral approximations. Code validation is accomplished by comparison of the numerical results to both linear stability theory and to experiments. Calculations of two- and/or three-dimensional sinuous mode disturbances in the wake of a flat plate are undertaken. For calculations of two-dimensional disturbances, the wake is forced at an amplitude level so that nonlinear disturbance development may be observed. In addition, the forcing amplitude is varied in order to determine its effect on the disturbance behavior. To investigate the onset of three-dimensionality, the wake is forced with a small-amplitude three-dimensional disturbance and a larger amplitude two-dimensional disturbance. The two-dimensional forcing amplitude is varied in order to determine its influence on the three-dimensional flow field. Two-dimensional disturbances are observed to grow exponentially at small amplitude levels. At higher amplitude levels, nonlinear effects become important and the disturbances saturate. The saturation of the fundamental disturbance appears to be related to the stability characteristics of the mean flow. Larger forcing amplitudes result in the earlier onset of nonlinear effects and saturation. At large amplitude levels, a Karman vortex street pattern develops. When the wake is forced with both two- and three-dimensional disturbances, strong interactions between these disturbances are observed. These interactions result in saturation effects in both disturbances, and complicated distributions of vorticity, and a significant increase in the wake width. Dissert. Abstr.

N91-12631 ESDU International Ltd., London (England).
INTRODUCTION TO TRANSONIC AERODYNAMICS OF AEROFOILS AND WINGS Abstract Only
Apr. 1990 43 p
(ESDU-90008; ISBN-0-86579-734-0; ISSN-0141-4356) Avail: ESDU

The flow phenomena that occur in steady high subsonic flow over airfoils and wings, and the prediction of the initial stages of shock-induced separation are discussed. The development of regions of supersonic flow on an airfoil is first considered, at constant angle of attack as Mach number increases and at constant Mach number as angle of attack increases. The influence of various features of the flow, illustrated by visualization photographs, on the airfoil aerodynamic characteristics is shown graphically. The interaction in attached flow of the shock with a turbulent boundary layer is considered and a correlation shows the effect of the upstream boundary layer conditions on the length of the interaction region. Shock-induced separation is then discussed, also illustrated with graphs of the Mach number contours in the vicinity of the

shock and corresponding flow visualization pictures, and the types of separation met are explained. A broad criterion for separation is suggested and a correlation of separation bubble length in terms of the upstream boundary layer parameters is included. A correlation of conditions for flow breakdown is also given. There is a brief discussion of the occurrence of transonic conditions on high lift devices, where supersonic flow can exist at free stream Mach numbers as slow as 0.2. Finally, three-dimensional effects are considered, initially in terms of the infinite yawed wing, and then in terms of the tip effects introduced with finite aspect ratio. ESDU

N91-12632 Bradford Univ. (England).
SEPARATED FLOW ON A HIGH LIFT WING: A STUDY OF THE TURBULENT CHARACTERISTICS OF THE SEPARATED FLOW REGION ON A HIGH LIFT WING UNDER NORMAL AND WING BODY CONDITIONS BY MEANS OF A FLYING HOT-WIRE TECHNIQUE Ph.D. Thesis
Hussain Hammod Al-Kayiem 1989 457 p
Avail: Univ. Microfilms Order No. BRD-89961

The large separation of turbulent wall shear layer from high lift wings is discussed. An experimental investigation was carried out measuring the flow field, including large separation region, over a high lift wing model having an NACA 4412 aerofoil section. A new procedure was developed to design and manufacture the wing model using computer aided design-manufacturing (CAD-CAM) facilities. The investigation contains a comparison of two wing configurations: (1) Clean wing, (2) Wing/Body interference. The main measuring instrumentation was the flying hot-wire (FHW). The related kinematic, electronic, and operating software of the FHW system are discussed, as well as the transformation of the FHW signals into useful information of the flow field. The development and testing of new calibration of the X hot-wire probe is presented. The developed procedure increases the accuracy of measurement in highly turbulent flow. To implement this method, an in-situ calibration of the X FHW was adopted. The data acquisition (system and procedure) was implemented digitally using a minicomputer interfaced to various electronic circuits. Suitable software was developed and used for sampling, digitizing and on-line analysis of the FHW signals. The developed analysis enabled transformations of the FHW signals into mean velocity components and turbulence statistical quantities. The FHW system was found to give accurate results both in reverse, as well as in the streamwise flow field. The results obtained were presented in the format of profiles, velocity vectors fields, contour plots, colored shadings, and probability distributions to characterize both the mean flow and the associated turbulence. Dissert. Abstr.

N91-12633# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
COMPUTATION OF UNSTEADY TRANSONIC FLOWS USING AN IMPLICIT CENTERED EULER SOLVER WITHOUT ARTIFICIAL VISCOSITY Ph.D. Thesis - Paris VI Univ.
Anne-Marie Sens Sep. 1990 98 p In FRENCH; ENGLISH summary Report will also be announced as translation (ESA-TT-1235) Original contains color illustrations
(ONERA-NT-1990-8; ISSN-0078-3781; ETN-90-98023) Avail: NTIS HC/MF A05

The numerical simulation of unsteady transonic flows are studied. The Euler equations are solved using an extension of Lerat's centered scheme. This scheme is able to work without artificial viscosity. The aim is to extend this property to real unsteady problems. Two approaches are developed in the 1-D case. In the first one, nonlinearities are taken into account in the construction of the scheme but oscillations in the numerical structure of moving shock waves are not avoided. The second approach leads to a modification of the second order terms in the implicit scheme allowing a better control of the numerical dissipation. A local time step is introduced in addition to the uniform time step. The two time step scheme is extended in 2-D using the approach developed by Lerat and Sides in the steady case. A stability result is given in the scalar case. The method is applied to the unsteady transonic flow calculation around an airfoil in rigid body motion. The two time step method is validated in 3-D case for the problem of a swept wing oscillating in translation between parallel walls. ESA

N91-12634# Fluid Physics, Inc., Encinitas, CA.
SIMULANT GAS TEST TECHNIQUE FEASIBILITY Final Report, Dec. 1988 - Jan. 1990
Richard M. Traci May 1990 85 p
(Contract F33615-88-C-3011)
(AD-A224878; R90-09-03; WRDC-TR-90-3023) Avail: NTIS HC/MF A05 CSCL 20/4

The uncertainty engendered by non-equilibrium air effects on hypersonic vehicle aerodynamics and heat transfer is compounded by the fact that such effects are difficult to validate in ground test facilities. Laboratory quality ground test data on air chemistry effects are clearly needed to investigate the rich parametric effects of scale, complex geometry, turbulence coupling, and altitude/Mach number flight regime. Moreover, data is needed for numerical model validation purposes. A proposed concept for such a test, referred to as the Simulant Gas shock tunnel test, is investigated. The approach is based on the use of simulant gas mixtures in a shock tunnel operating in the nonreflected shock mode. Simulant gases are sought which react at lower temperatures than oxygen and which have a relatively well defined ignition temperature. They thereby provide the possibility of remaining unreacted in the freestream of the expanded shock tunnel flow while reacting at representative and controllable rates in the shock layer of a test model. The test concept, if feasible, would provide a laboratory quality experimental simulation technique which possesses reactive flow similitude relative to oxygen dissociation at hypersonic flight conditions. The feasibility of the simulant gas test concept was evaluated by performing reactive flow scaling and reactive streamline flow analyses for a limited range of combustible gas mixtures. The method is illustrated for air by defining flight regimes and baseline shock tunnel test regimes for which nonequilibrium oxygen dissociation is operative in the vehicle/model shock layer. GRA

N91-12635# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Hubschrauber und Flugzeuge.
CALCULATION OF NONSTATIONARY TWO AND THREE DIMENSIONAL FLOWS AROUND A CARRYING WING USING AN IMPLICIT RELAXATION PROCESS, IN ORDER TO SOLVE THE EULER EQUATIONS Thesis - Univ. der Bundeswehr Neubiberg [BERECHNUNG INSTATIONAERER ZWEIG- UND DREIDIMENSIONALER STROEMUNGEN AM TRAGFLUEGEL MITTELS EINES IMPLIZITEN RELAXATIONSVERFAHRENS ZUR LOESUNG DER EULERGLEICHUNGEN]
Alfred Brenneis 12 Mar. 1990 236 p In GERMAN
(MBB/FE122/S/PUB/394; ETN-90-97843) Copyright Avail: NTIS HC/MF A11

A calculation process is developed in order to solve the nonfactorized, implicit Euler equations using a relaxation process. The starting point is a stationary finite volume Euler process, which is first extended to the non stationary parts, for temporarily modified boundary conditions. In order to reduce the total calculation time, the solution of the implicit Euler equations through an explicit process was not taken into account. The first time use of a relaxation process for nonstationary flow calculation represented the center point of the work. The decisive point was the use of a nonlinear Newton method, which by means of a Punkt-Gauss-Seidel algorithm is resolved with an iteration. Detailed 2-D and 3-D test calculations with parameter variations were carried out at harmonic pitching carrying wings. The accelerating factor in relation to the explicit version is dependent of the network fineness, the reduced frequency, and the CFL number between 5 and 300, and is independent of it, if a 2-D or 3-D problem is involved. ESA

N91-12636# Naval Postgraduate School, Monterey, CA.
AEROPREDICTIVE METHODS FOR MISSILE ANALYSIS M.S. Thesis
Archibald S. Dunn Dec. 1989 85 p
(AD-A225403) Avail: NTIS HC/MF A05 CSCL 16/2

Various computational methods and operational computer codes used to predict and evaluate aerodynamic coefficients and flight performance of missile bodies are reviewed. Aerodynamic effects of symmetric and asymmetric flow separation are discussed, as are the differences inherent in estimating the properties of the resulting flowfields. The semi-empirical aeroprediction codes NSWC and MISSILE DATCOM are compared against experimental data for a variety of configuration geometries and flight conditions; the MISSILE DATCOM code is further used for a comparison with wind tunnel data for a Standard-type missile model. The NSWC and MISSILE DATCOM codes are found to provide accurate prediction of normal force coefficients at both low and high angle of attack, although the nonlinear effects of separated flow are only partially captured. Center of pressure coefficients are generally underpredicted, but of the correct order of magnitude. The accuracy of drag coefficient prediction is seen to diminish as missile configuration geometry becomes more complex. The NSWC program provides satisfactory prediction of pitch damping coefficients, while the MISSILE DATCOM output is inconclusive. The NSWC and MISSILE DATCOM aeroprediction codes are considered suitable for preliminary design and aerodynamic analysis. GRA

N91-12637# Princeton Univ., NJ.
INVESTIGATION OF SUPERSONIC BOUNDARY LAYER TRANSITION AND TURBULENT STRUCTURE Final Report, 1 Dec. 1988 - 1 Mar. 1990
A. J. Smits and R. B. Miles 24 Jul. 1990 20 p
(Grant AF-AFOSR-0091-89; AF Proj. 2307)
(AD-A225996; AFOSR-90-0875TR) Avail: NTIS HC/MF A03 CSCL 20/4

This final report describes the research progress made possible with the equipment purchased under this grant, and the manpower supplied by Princeton University as part of cost sharing. GRA

N91-12638# University of Southern California, Los Angeles. Dept. of Aerospace Engineering
HYPERSONIC VISCOUS FLOW Final Report, 1 Mar. 1988 - 31 May 1990
Hsien K. Cheng 26 Jul. 1990 5 p
(Grant AF-AFOSR-0146-88; AF Proj. 2307)
(AD-A226072; AFOSR-90-0885TR) Avail: NTIS HC/MF A01 CSCL 20/4

Research and documented works on viscous hypersonic flow theory are summarized and reported. Topic areas where the research has been focused are a fully viscous version of the shock layer (VSL) and its extension beyond the Navier-Stokes (NS) level based on Grad's thirteen moment equations and INVISCID-VISCOUS iteration in hypersonic flows. The development in the former area has led to a principle which allows correlation of shock layer flow far from translational equilibrium with a corresponding flow based on the NS equations, as substantiated by extensive comparison of direct simulation Monte Carlo and NS-based calculations. The development in the latter area resulted in a triple-deck theory of hypersonic boundary layer under strong wall cooling which exhibits drastically different structure and properties of the triple-deck. GRA

N91-12639# Universal Energy Systems, Inc., Dayton, OH.
RESEARCH IN FLIGHT DYNAMICS Final Report, May 1986 - May 1989
Gary D. Streby Jun. 1990 28 p
(Contract F33615-86-D-3800)
(AD-A226123; WRDC-TR-90-3040) Avail: NTIS HC/MF A03 CSCL 01/1

The Research in Flight Dynamics Program provided the resources and specialized personnel to conduct multidiscipline research studies and investigations to support the efforts of the Air Force Flight Dynamics Laboratory. These studies involved advanced technology areas that may be implemented in advanced Air Force weapon systems. Technical disciplines that were investigated included such areas as vehicle dynamics, flight control, mechanical subsystem DBMS software development, numerical simulations of complex aerodynamic problems, aerodynamics, and data analysis. Management of this program required the definition of individual tasks, providing in-house expertise or obtaining specialized expertise to conduct the assigned tasks, and management of funding and scheduling of all efforts. GRA

N91-12640# Ballistic Research Labs., Aberdeen Proving Ground, MD.
PREDICTION OF IN-BORE AND AERODYNAMIC HEATING OF KE PROJECTILE FINS Final Report, Jun. 1988 - Aug. 1989
Walter B. Sturek, Harry A. Dwyer, and Earl N. Ferry, Jr. Aug. 1990 37 p
(AD-A226402; BRL-MR-3852) Avail: NTIS HC/MF A03 CSCL 19/1

Current high velocity kinetic energy penetrator shell use fins made of aluminum to provide aerodynamic stability. Due to the high velocity of the shell and the requirement to keep the drag of the shell to a minimum, these aluminum fins are very thin, a maximum thickness of 4 mm is typical. The thin cross section of the fin and the low melting point of aluminum combine to create a critical design problem. If the fins do not have sufficient mass to absorb and conduct away the high heat loads imposed in-bore and in-flight, the fins will ablate and cause erratic flight due to distortion to the fin or the lack of sufficient fin area to maintain stability. This report discusses the development of an improved predictive capability to model the unsteady heat conduction of fin configurations of interest to the Army. Two modeling capabilities are described: (1) the full three-dimensional geometry of the fin for a fixed geometry; and (2) a quasi-three dimensional, two-phase modeling of the fin in which melting of the fin is simulated with a moving boundary that recedes as the material reaches melt temperature. Sample computations are shown which illustrate the unsteady, thermal response of KE projectile fins to aerodynamic heating. GRA

N91-12641# Ballistic Research Labs., Aberdeen Proving Ground, MD.
SPIKE-NOSED PROJECTILES: COMPUTATIONS AND DUAL FLOW MODES IN SUPERSONIC FLIGHT Final Report, Jan. - Dec. 1989
Ameer G. Mikhail Aug. 1990 44 p
(DA Proj. 1L1-62618-AH-80)
(AD-A226433; BRL-TR-3140) Avail: NTIS HC/MF A03 CSCL 19/1

This study was made to assess the capability of a Computational Fluid Dynamic (CFD) method to adequately determine the aerodynamic coefficients for the unusual configurations of sharp-edged, spike-nosed projectiles that are of interest to the U.S. Army. McCormack's time-dependent, explicit scheme was used for the full Navier-Stokes equations in a zonal gridding topology. Three configurations were computed at Mach = 1.72 and zero angle of attack. The results are compared against wind tunnel data. The flow fields computed are in qualitative agreement with wind tunnel schlieren photographs, and the computed drag coefficients are within two percent of the wind tunnel measurements. Two important issues are faced: (1) the always existing possibility of a dual flow mode and which one will occur under specific flow conditions; and (2) observed role of the turbulence level and numerical model in affecting flow separation and, thus, influencing a particular flow mode to be predicted. This study demonstrates the successful application of the present approach to these unusual configurations and, thus, leads the way to further application for more complex configurations, such as those with booms and fins. GRA

N91-12642# Institut Franco-Allemand de Recherches, Saint-Louis (France).
HYPERSONIC AERODYNAMICS OF GUIDED PROJECTILES [HYPERSCHALLAERODYNAMIK LENKBARER GESCHOSSE]
K. W. Naumann 29 Dec. 1988 74 p In GERMAN Presented at CCG-Lehrgang B2.19, Weil am Rhein, Fed. Republic of Germany, 21-24 Nov. 1989; and Seminar Aussenballistik bei der BAkWVT,

Mannheim, Fed. Republic of Germany, 6-8 Mar. 1989
(ISL-CO-259/88; ETN-90-98028) Avail: NTIS HC/MF A04

The particular laws of hypersonic flows are reviewed. Approximation methods, such as the Newton method, the shock expansion method and the tangent-cone tangent-wedge method, are presented. The Tsien parameter and the principle of the unstationary equivalence are depicted. Several optimal projectile shapes are described. The problems of aerodynamic stability and piloting are examined. ESA

N91-12643 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Hubschrauber und Flugzeuge.
TEST OF TURBULENCE MODELS FOR HYPERSONIC FLOWS Thesis - Tech. Univ. Munich [ERPROBUNG VON TURBULENZMODELLEN FUER HYPERSCHALLSTROEMUNGEN]
G. Hein 11 Jun. 1990 74 p In GERMAN
(MBB/FE122/S/PUB/401; ETN-90-98152) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

The importance of density variations in turbulence models is discussed. A one layer turbulence model similar to the Prandtl mixing model, that takes into consideration the compressibility effects by a density gradient was developed. It was compared with other algebraic models in the hypersonic area. A coupling with a two layer model was realized and temperature, velocity and Mach number profiles were studied to determine the best results in which area. It is concluded that the separation of the turbulent boundary layer in two layers is a good solution. ESA

N91-12644# Technische Hochschule, Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen.
DISTURBED COMPRESSIBLE PLATE WAKES Ph.D. Thesis [GESTOERTE KOMPRESSIBLE PLATTENNACHLAEUFE]
Wolfgang Althaus 1989 130 p In GERMAN
(ETN-90-98190) Avail: NTIS HC/MF A07

The disturbed compressible wake of a longitudinally flowed flat plate, whose surface was optionally smooth or roughened, was examined. The experiments were conducted in subsonic and hypersonic field for a Reynolds number of Reynolds length equal to 4.4 x 10 (exp 6) at Mach number = 2.2. Differential interferometry and holographic interferometry were used. The wake of smooth plate was turbulent, while a vortex path could be generated in the wake of the roughened plate. The conditions under which a vortex path could be generated, were examined. The development of the boundary layer along the plate was measured. A similitude analysis of the turbulent wake was conducted and the influence of the turbulent density fluctuations on the development of a similar wake was considered. A linear local stability analysis with global criterion was carried out with velocity profiles on the near wake. The calculated Strouhal numbers were compared to the measured Strouhal numbers. The interaction between a compression shock and a turbulent wake was experimentally examined. ESA

N91-12645# Karlsruhe Univ. (Germany, F.R.). Inst. fuer Stroemungslehre und Stroemungsmaschinen.
CALCULATION OF TRANSONIC, FRICTION BETWEEN AFFECTED CHANNELS AND PROFILE FLOWS WITH PASSIVE INFLUENCE Ph.D. Thesis [BERECHNUNG TRANSSONISCHER, REIBUNGSBEHAFTETER KANAL- UND PROFILSTROEMUNGEN MIT PASSIVER BEEINFLUSSUNG]
Thomas Breitling 1989 94 p In GERMAN
(ETN-90-98192) Avail: NTIS HC/MF A05

A multicomponent process is described, which allows calculation of ventilated and non-ventilated transonic tunnel flows. A new process for producing a contour matched orthogonal calculation net with controllable line density in tunnels is presented. The further development of the model for the description of the interference range is emphasized. Sensitivity examinations for the extension of the interference zone are conducted. The flow volume in the interference zone and in the tunnel are represented in diagrams. The boundary layer measures confirm the models used. The implementation of the interface model and of the chamber calculation in an already existing program for the calculation of airfoils is described. It is shown that the process used here with the implementated interference model is in good agreement with pressure and boundary layer measures. ESA

N91-12646# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Luftfahrttechnik und Leichtbau.
A VORTEX LATTICE METHOD FOR THE CALCULATION OF INTERFERENCE EFFECTS BETWEEN WINGS AND FREE VORTEX SHEETS IN SUBSONIC FLOW Ph.D. Thesis [EIN WIRBELGITTERVERFAHREN ZUR BERECHNUNG VON INTERFERENZEFFEKTEN SWISCHEN TRAGFLAECHEN UND FREIEN WIRBELSCHICHTEN BEI UNTERSCHALLSTROEMUNG]
Christine Urban 1988 155 p In GERMAN; ENGLISH summary
(Grant DFG-WA-424/3)
(ETN-90-98196) Avail: NTIS HC/MF A08

A time dependent zero order singularity method was developed to gain a simple and appropriate mathematical method for the calculation of the basis interference effects between wings and free vortex sheets. The method is suited for plane thin wings and subsonic flow conditions. The discontinuity surfaces are represented by a discrete vortex lattice. Thanks to the vortex lattice method, the mathematical and numerical advantages of a zero order potential method are combined with an increased accuracy of the velocity field, which represents an essential precondition for the calculation of interfering wings with vortex separation. The simulation of unsteady incompressible processes is possible. The vortex lattice method provides a reliable tool for the lay out process, for experimental investigations, and for more detailed theoretical studies. ESA

N91-12517# Kyushu Univ., Fukuoka (Japan). Dept. of Aeronautical Engineering.
NUMERICAL CALCULATIONS OF SEPARATED FLOWS AROUND A WING SECTION AT UNSTEADY MOTION BY A DISCRETE VORTEX METHOD
Shigeru Aso, Atsushi Fujimoto, Naoki Futatsudera, and Masanori Hayashi (Nippon Inst. of Tech., Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 27-32 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12518# Institute of Computational Fluid Dynamics, Tokyo (Japan).
UNSTEADY CALCULATION OF THE TRANSONIC FLOW OVER ONERA-M6 WING WITH A SIDE WALL
Takuya Sakuragi and Keisuke Kamo (Fuji Heavy Industries Ltd., Utsunomiya, Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 33-37 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12519# National Aerospace Lab., Tokyo (Japan).
TURBULENCE MODELS FOR TRANSONIC FLOWS WITH SEPARATION
Yoko Takakura, Satoru Ogawa, and Tomiko Ishiguro *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 39-44 In JAPANESE; ENGLISH summary Prepared in cooperation with Fujitsu Ltd., Tokyo, Japan (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12522# National Aerospace Lab., Tokyo (Japan).
COMPUTATION OF THREE-DIMENSIONAL CHEMICALLY REACTING FLOWS AROUND RE-ENTRY VEHICLES
Yasuhiro Wada, Satoru Ogawa, and Tomiko Ishiguro *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 59-63 In JAPANESE; ENGLISH

summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12523# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
A HYPERSONIC THERMALLY-NONEQUILIBRIUM REACTING FLOW AROUND A THREE-DIMENSIONAL BLUNT BODY
K. V. Reddy, Toshi Fujiwara, and Toshi Murayama *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 65-70 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12525# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL STUDY ON INJECTED JET INTO A SUPERSONIC FLOW
Masahiro Takahashi and Koichi Hayashi *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 77-80 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12535# National Aerospace Lab., Tokyo (Japan).
A NUMERICAL SIMULATION FOR SUPERSONIC INTAKE
Jungi Shigematsu, Kuzuomi Yamamoto, and Atsushige Tanaka (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 135-139 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12544# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF FLOW FIELDS AROUND AN AIRPLANE OF COMPLEX GEOMETRIES
Masakazu Tachibana and Susumu Takanashi *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 195-199 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12548# National Aerospace Lab., Tokyo (Japan).
RAREFIED GAS NUMERICAL WIND TUNNEL. 5: VORTEX SHEDDING BEHIND AN INCLINED FLAT PLATE
Katsuhisa Koura and Emi Kanematsu (Fujitsu Ltd., Tokyo, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 221-224 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12550# National Aerospace Lab., Tokyo (Japan).
COMPARATIVE STUDY ON WING PRESSURE DISTRIBUTION OF HIGH SPEED JET AIRPLANE BETWEEN NUMERICAL SIMULATION AND FLIGHT TEST
Junichi Miyakawa (Mitsubishi Heavy-Industries Ltd., Tokyo, Japan) and Susumu Takanashi *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 231-236 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12551# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF TRANSONIC FLOWS OVER BOEING-747 AND ITS VALIDATION BY COMPARISON WITH EXPERIMENTAL DATA
Ryozo Ito, Susumu Takanashi, Kisa Matsushima, Motomu Sato, Kozo Fujii, and Edward N. Tinoco (Boeing Commercial Airplane Co., Seattle, WA.) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 237-241 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12552# Tottori Univ. (Japan). Dept. of Applied Mathematics and Physics.
NUMERICAL SIMULATION OF WING IN GRAND EFFECT 2
T. Kawamura and Shozo Kubo *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 243-247 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12553# National Aerospace Lab., Tokyo (Japan).
EFFECTS OF BLADE TIP PLANFORMS ON ROTOR PERFORMANCE IN HOVER
Takashi Aoyama, Keiji Kawachi (Tokyo Univ., Japan), and Shigeru Saito *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 249-254 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12554# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
A PRELIMINARY STUDY OF TRANSONIC FLOW AROUND NACA0012
Andi E. Sakya, Yoshiaki Nakamura, and Michiru Yasuhara *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 255-264 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12555# National Aerospace Lab., Tokyo (Japan).
TRANSONIC AERODYNAMICS ANALYSES OF UNCONVENTIONAL WING CONFIGURATIONS BY 3D-EULER CODE
Masakata Hashimoto (Mitsui Engineering and Shipbuilding Co. Ltd., Tokyo, Japan), Naoki Hirose, and Takeshi Ohnuki *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 265-271 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12556# National Aerospace Lab., Tokyo (Japan). Computational Aerodynamic Section.
AERODYNAMIC SIMULATION OF FLOWS ABOUT A SPACE-PLANE 3
Kisa Matsushima, Susumu Takanashi, and Kozo Fujii (Tokyo Univ., Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 273-278 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12559# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF HYPERSONIC FLOW AROUND H-2 ORBITING PLANE
Yukimitsu Yamamoto, Toshio Akimoto, and Naoyuki Suzuki (AES, Inc., Tsukuba, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 295-301 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12572*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN AIRFOIL FOR GENERAL AVIATION APPLICATIONS
Michael S. Selig, Mark D. Maughmer (Pennsylvania State Univ., University Park.), and Dan M. Somers *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 280-291 (For primary document see N91-12563 04-01)
(Grant NGT-50341)
Avail: NTIS HC/MF A17 CSCL 01A

N91-13330*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.
THE SEMIDISCRETE GALERKIN FINITE ELEMENT MODELING OF COMPRESSIBLE VISCOUS FLOW PAST AN AIRFOIL
Andrew J. Meade *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 86-87 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N91-12647# Failure Analysis Associates, Inc., Westborough, MA.
FAILURE ANALYSIS TECHNIQUES FOR THE EVALUATION OF ELECTRICAL AND ELECTRONIC COMPONENTS IN AIRCRAFT ACCIDENT INVESTIGATIONS Final Report, 20 Sep. 1989 - 20 Apr. 1990
Donald Galler, Donald E. Allison, and David W. Mercaldi Aug. 1990 149 p
(Contract F33615-89-C-5647; AF Proj. 3005)
(AD-A226381; WRDC-TR-90-4075) Avail: NTIS HC/MF A07 CSCL 09/1

Failure analysis techniques for the evaluation of electrical and electronic components are summarized for: lamps, wiring, connectors, switches, magnetic materials, printed wiring boards and microelectronic devices. Techniques using optical and scanning electron microscopy (SEM) for the analysis of these components are described. Energy Dispersive X ray analysis (EDAX) of elemental constituents, X ray radiography, and specialized electrical measurements are also described. The potential for the techniques to distinguish pre-accident conditions from post-impact damage was assessed. Data on the failure rates of aircraft electrical components was reviewed. Data from the Air Force Mishap database indicates that 36 percent of electrical failures on aircraft are caused by interconnections: wiring and connectors. Corrosion is identified as a major cause of connector problems. GRA

N91-12571# University of Western Michigan, Kalamazoo. Dept. of Aircraft and Automotive Engineering.
PERFORMANCE INSTRUMENTATION FOR MULTIENGINE SAFETY
Arthur W. Hoadley *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 260-279 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12573# Goldschmied (Fabio R.), Monroeville, PA.
AERODYNAMIC TRANSPORT EFFICIENCY OF GENERAL AVIATION: AN OVERVIEW
Fabio R. Goldschmied *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 292-311 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N91-12648# Mitre Corp., Bedford, MA.
EXAMINATION OF RTCA/DO-198 POSITION RECONSTRUCTION ALGORITHMS FOR AREA NAVIGATION WITH THE MICROWAVE LANDING SYSTEM Final Report
John W. Hall, Patricia M. Hatzis, and Frederic D. Powell Jun. 1990 57 p
(Contract F19628-89-C-0001; AF Proj. 5420)
(AD-A224804; MTR-10766; ESD-TR-90-308) Avail: NTIS HC/MF A04 CSCL 17/7

Use of the Microwave Landing System (MLS) for area navigation and computed centerline approach requires that the MLS avionics determine the aircraft position in Cartesian coordinates relative to the runway centerline. The inputs to the avionics are the locations of the three MLS ground units and the three observations of distance, azimuth angle, and elevation angle. When the three ground units are not collocated, this process requires an iterative algorithm. A March 1988 publication of the Radio Technical Commission for Aeronautics (RTCA) presents five such algorithms. These algorithms have various problems, such as errors in the analyses and/or computer code, and divergence or false solutions, etc., within the minimum coverage area of the MLS. This report, which identifies the various problems and offers corrections, concentrates on the two algorithms that assume a conical MLS azimuth antenna, as that is likely to be the only type that will be developed. GRA

N91-12649# Georgia Inst. of Tech., Atlanta. Computer Engineering Research Lab.
GUIDANCE, NAVIGATION AND CONTROL. DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 1, TASK 1: DIGITAL EMULATION TECHNOLOGY LABORATORY Annual Report, FY90
Thomas R. Collins and Stephen R. Wachtel 22 Jul. 1990 65 p
(Contract DASG60-89-C-0142)
(AD-A225123; AR-0142-90-001-Vol-1) Avail: NTIS HC/MF A04 CSCL 15/3

This report addresses the objectives, requirements, and schedule of the Digital Emulation Technology Laboratory (DETL). There are two main hardware systems: the Parallel Function Processor (PFP) and the Seeker Scene Emulator (SSE). Each of these systems is a complex parallel processor, and they are designed to function together as an emulation facility for kinetic energy weapons systems. Software development is also an active area of research, both at the system level (compilers, loaders, graphics development) and at the application level (simulation and emulation studies). The principal objectives of DETL are as follows: Provide facilities for 6-DOF KEW emulation; Provide real-time capability in excess of 2000 Hz; Provide real-time emulation of IR FPA seekers; Test and verify GN and C software and hardware systems; and Educate new PFP users and provide technical support. GRA

N91-12650# Georgia Inst. of Tech., Atlanta. Computer Engineering Research Lab.
GUIDANCE, NAVIGATION AND CONTROL. DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 4, TASK 6: PARALLEL FUNCTION PROCESSOR DEVELOPMENT Annual Report, for FY90
Michael B. Woods, Richard M. Pitts, and Phillip R. Bingham 19 Jul. 1990 40 p
(Contract DASG60-89-C-0142)
(AD-A225126; AR-0142-90-001-Vol-4) Avail: NTIS HC/MF A03 CSCL 15/3

The DETL (Digital Emulation Technology Laboratory) simulation hardware centers on the development, implementation, and use of the Parallel Function Processor (PFP). The PFP is a 64 processor digital computer for use in computationally intensive applications that can be partitioned into functional blocks. The processors are grouped in two 32 processor clusters running from one common host. Each 32 processor cluster is connected by a crossbar switch. All inter-processor communication takes place over the crossbar(s). Simultaneous transfers may take place independently and switch patterns may be changed every cycle. In order to program the machine correctly, all inter-processor communication and data transfer lengths must be known beforehand. Within DETL, there are two main hardware systems: The PFP and the Seeker Emulator. (The Seeker Emulator is covered in volume 2 of this report.) The two systems are designed to function together as a simulation/emulation facility for kinetic energy weapons systems. The principal objectives of the DETL are as follows: Provide facilities for 6-DOF KEW emulation; Provide real-time capability in excess of 2000 Hz; Provide support for nonlinear functions; Provide real-time emulation of IR FPA seekers; and To provide a facility for testing and verification of GN and C. GRA

N91-12651# Georgia Inst. of Tech., Atlanta. Computer Engineering Research Lab.

GUIDANCE, NAVIGATION AND CONTROL. DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 5, TASKS 4, 5, AND 7: SOFTWARE DEVELOPMENT AND GN AND C PROCESSOR DEVELOPMENT Annual Report, for FY90

W. S. Tan and Karsten Schwan 22 Jul. 1990 91 p
(Contract DASG60-89-C-0142)
(AD-A225127; AR-0142-90-001-Vol-5) Avail: NTIS HC/MF A05 CSCL 15/3

A set of VLSI chips is being designed for the guidance, navigation, and control (GN and C) of KEW interceptors. The GN and C processor consists of three types of architectures: executive processor (EP), data processor (DP), and signal processor (SP). The EP is a general purpose processor with extensive general processing, numerical, and I/O capabilities. The DP is a numerical processor that is specifically designed to solve ordinary differential equations associated with closed-loop control systems. The SP is designed to process image data from a high resolution focal plane array. These processings include several filtering stages, an object clustering stage, and an object centroiding stage. Two VLSI chips are associated with the EP design. They are in the design stage. All the VLSI chips associated with the DP have been fabricated and tested. A prototype multiwire DP module has also been built and tested. Six VLSI chips are associated with the SP design. Three are in the design stage. Three are currently being fabricated. The integrated parallel programming framework (IPPF) is a parallel programming environment for the development of parallel software applications targetted for the GN and C processor and the real-time simulation testbed (Parallel Function Processor). The environment features a graphical programming front-end interface that allows system programmers to construct application and system software based on block diagram programming approach. Most work is concentrated on the low level utilities that are necessary to construct the integrated framework. The front-end graphical interface is still in its early stages of development. GRA

N91-12652# Synetics Corp., Wakefield, MA.

ANALYSIS OF GPS TIMING DATA IN SUPPORT OF OMEGA SYSTEM SYNCHRONIZATION: A CESIUM STABILITY STUDY Final Report, Jul. 1988 - Apr. 1990

G. Noseworthy, L. Sheynblat, and T. Palka Apr. 1990 259 p
(Contract DTCG23-86-A-20022)
(AD-A225507; J-191-6; USCG-ONSCEN-02-90) Avail: NTIS HC/MF A12 CSCL 17/7

The use of Global Positioning System (GPS) precise time-transfer has the potential for improving the accuracy and the efficiency of Omega synchronization. Under the present scheme of synchronization, designed long before the availability of global time-transfer, synchronization adjustments were made once per week. These adjustments are based on a statistical estimate of timing errors derived from very-long-baseline reciprocal path phase measurements. This report examines an alternate approach to synchronization using GPS as the primary means of measuring timing errors at individual stations, independent of other stations. A Covariance Simulation Program (CSP) has been developed to simulate the behavior of cesium frequency standards under various error correction schemes. The CSP is based on a cesium stability model and accepts actual Omega station data as input to model the rate of growth of timing errors under various scenarios. The results of the CSP can then be used to support decisions on the architecture of the synchronization process. Associated with this report is an Addendum showing sample CSP results and a CSP User's Guide. GRA

N91-12653# Mitre Corp., Bedford, MA.

A GAUSSIAN ALGORITHM USING COORDINATE ROTATION FOR AREA NAVIGATION OPERATIONS WITH THE MICROWAVE LANDING SYSTEM Final Report

John W. Hall, Patricia M. Hatzis, and Frederic D. Powell Jun. 1990 51 p
(Contract F19628-89-C-0001; AF Proj. 5420)
(AD-A225642; MTR-10765; ESD-TR-90-315) Avail: NTIS HC/MF A04 CSCL 17/7

The Microwave Landing System (MLS) avionics convert the received signals of range, azimuth angle, and elevation angle to yield aircraft position in Cartesian coordinates. This enables area navigation and computed centerline approaches, including multi-leg and curved approaches. When the three MLS ground units are not collocated, this requires iteration. The speed of convergence and the size of the algorithm and its computational burden affect the MLS avionics storage and timing requirements. Gaussian algorithms tend to be relatively compact but diverge at azimuth angles within the coverage of the MLS, while Newton-Raphson algorithms require more storage and impose a greater computational burden. This report presents a Gaussian algorithm which, by rotating the coordinate system, enables fast convergence everywhere within the MLS coverage, and with a computational burden significantly less than an equivalent Newton-Raphson algorithm. GRA

N91-12654# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

A DISTRIBUTED MODEL FOR MOBILE ROBOT ENVIRONMENT-LEARNING AND NAVIGATION M.S. Thesis

Maja J. Mataric May 1990 132 p Revised
(Contracts N00014-85-K-0124; N00014-86-K-0685; SI-804475-D)
(AD-A225711; AI-TR-1228) Avail: NTIS HC/MF A07 CSCL 12/9

This thesis presents a method for robust mobile robot navigation, large space learning, and path planning, based on a totally distributed architecture. The described methods were implemented and tested on a physical robot. The robot, Toto, consists of an omnidirectional base supplied with a ring of twelve ultrasonic ranging sensors and a compass. It is fully autonomous with all power and processing onboard. All experimental data were gathered in unaltered office environments with static and dynamic obstacles. Toto is an example of incremental design methodology. The robot was programmed in the Behavior Language, based on the subsumption architecture. Its behavior consists of three real-time, reactive layers of competence: collision-free boundary tracing, landmark detection, and environment learning and path planning. Low-level navigation consists of a collection of simple reflex-like rules which, when acting in parallel, result in an emergency boundary-tracing behavior. This behavior is used by the landmark detector which dynamically extracts features from the environment using the way the robot is moving as it is moving. The landmarks are used to construct a distributed map of the environment. The map is represented as a graph of landmarks. The links in the graph are used to indicate topological adjacency, and are assigned dynamically. The structure of the environment is used to bound the outdegree of the graph nodes resulting in linear graph connectivity. GRA

N91-12655# Federal Aviation Administration, Washington, DC. Office of Management Systems.
FAA AIR TRAFFIC ACTIVITY: FISCAL YEAR 1989
1989 213 p
(AD-A226063) Avail: NTIS HC/MF A10 CSCL 17/7

This FAA publication furnishes terminal and en route air traffic activity information of the National Airspace system. The data have been reported by the FAA-operated airport traffic control towers (ATCT's), air route traffic control centers (ARTCC's), flight service stations (FSS's), approach control facilities, and FAA contract-operated towers. These reports are used as a guide in determining the need for larger or additional facilities, and possible increases in personnel at existing facilities. Tables in chapter one show aircraft handled under instrument flight rules (IFR) at ARTC centers by aviation category, center, and region. Chapter two includes summaries of airport operations at FAA-operated towers by type of operation, aviation category, state, and region. Instrument operations at towers and radar approach control facilities (RAPCON's and RATCC's) are also included. Chapters three and four include summaries of instrument approaches at FAA ARTCC's and approach control facilities and secondary airports. Data for FSS's and IFSS's appear in chapter five. This information includes total flight services, IFR-DVFR and VFR aircraft contacted, IFR DVFR and VFR flight plans originated, pilot briefs, and airport advisories by facility, state, and region. Chapter six includes airport and instrument operations at FAA contract-towers by type of operation aviation category, state, and region. Rank order tables are provided to give the user a picture of the busiest facilities in the system. Historical tables are included where possible to show changes in growth. Hub designations are based on the number of enplanements within the 50 U.S. states and other U.S. areas as reported in Airport Activity Statistics of Certified Route Carriers.
GRA

N91-12656# Statistical Signal Processing, Inc., Yountville, CA.
SIGNAL-SELECTIVE HIGH-RESOLUTION DIRECTION FINDING IN MULTIPATH
Stephan V. Schell and William A. Gardner (California Univ., Davis.) 1990 6 p Repr. from Proceedings of the 1990 International Conference on Acoustics, Speech, and Signal Processing (IEEE), v. 5 p 2667-2670
(Contract DAAL03-89-C-0035)
(AD-A226225; ARO-26646.1-EL-S) Avail: NTIS HC/MF A02 CSCL 17/3

Existing high resolution direction finding techniques are limited in their performance and applicability by their lack of signal-selectivity. Although the recently invented Cyclic MUSIC algorithms address this problem by exploiting the spectral coherence properties of the signals of interest, they, like many conventional algorithms such as MUSIC, do not operate properly in the presence of fully correlated multipath. The algorithm presented here combines the signal-selectivity of Cyclic MUSIC with the ability to function well in the presence of fully correlated multipath. Analytical results and computer simulations are presented to support the claims, which include the ability to estimate directions of arrival of desired signals in the presence of multipath and arbitrary numbers of arbitrarily closely spaced interfering signals. Furthermore, a new algorithm can estimate the number of spectrally correlated signals with any particular cycle frequency, and it implicitly obtains maximum-SINR estimates of those signals.
GRA

N91-12657# Ship Analytics, Inc., North Stonington, CT.
RADIO AIDS TO NAVIGATION REQUIREMENTS: THE 1988 SIMULATOR EXPERIMENT Interim Report
J. W. Gynther and M. W. Smith Dec. 1989 105 p
(Contract DTCG23-86-C-20030)
(AD-A226235; USCG-D-08-90; Rept-89-U-026) Avail: NTIS HC/MF A06 CSCL 17/7

This report describes a man in the loop simulation experiment conducted to assist the U.S. Coast Guard in evaluating a requirement in the 1986 Federal Radionavigation Plan for an 8 to 20 meter (2 drms) system accuracy for piloting in restricted waterways. A variety of system accuracies were evaluated in several visibilities and with several display devices. All system accuracies and device displays supported performance approximating a visual piloting baseline in the straightaways. Turn performance was more sensitive to differences among conditions and was very poor in zero visibility. The findings support near-term implementation of such systems as electronic ranges or reduced visibility enhancements, but not as zero visibility/all-weather systems.
GRA

N91-12658# Civil Aeromedical Inst., Oklahoma City, OK.
CORRELATES OF TWO EXPERIMENTAL TESTS WITH PERFORMANCE IN THE FAA ACADEMY AIR TRAFFIC CONTROL NONRADAR SCREEN PROGRAM Final Report
David J. Schroeder, Carolyn S. Dollar, and Lendell G. Nye Aug. 1990 13 p Sponsored by FAA, Washington, DC
(AD-A226419; DOT/FAA/AM-90/8) Avail: NTIS HC/MF A03 CSCL 05/9

This study was designed to determine the relationships among experimental tests, the tests currently used to select entrants into the FAA's Air Traffic Control Specialist (ATCS) Academy Nonradar Screening Program, and Academy success. A battery of paper-and pencil tests, including the Directional Headings Test (DHT) which was developed at the Civil Aeromedical Inst., and subsequently modified for this study, and the Dial Reading Test (DRT) was administered to 1,225 students who entered in 1987. Scores on the current selection measures, the Multiplex Controller Aptitude Test (MCAT) and Abstract Reasoning Test, were obtained from the Office of Personnel Management (OPM). The pass, fail, and withdrawal rates for the sample were compared to performance levels on the experimental and OPM tests. Several Academy performance criteria and test results were intercorrelated and stepwise multiple regression analyses were conducted to predict overall Academy success and final grades. Results demonstrated that the DHT and DRT could be used to assess the potential of entrants to successfully complete the Academy Screen. Even though the current ATCS applicant group differs from those entering the Academy a decade ago on several dimensions (e.g., education and experience), the multiple correlation of the DHT, and MCAT scores with Academy success remained relatively unchanged. Results suggest there are other test measures which, when combined with the MCAT, would be better predictors than the existing battery of selection tests.
GRA

N91-12659# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
SATELLITE NAVIGATION IN CIVIL AVIATION
N. vanDriel 23 Dec. 1988 33 p Presented at NIN Symposium on Future Navigation, Communications and Surveillance Systems, 1 Dec. 1988
(NLR-TP-89009-U; ETN-90-98056) Avail: NTIS HC/MF A03

The use of satellites for aircraft navigation is discussed. Advantages over present systems, especially in terms of accuracy and coverage are described. A thorough review of the implications of the use of satellites for communications, navigation and surveillance by civil aviation is presented. An overview of the different satellite navigation systems that are implemented or under development is presented. Their potential for use by civil aviation is discussed.
ESA

N91-12660# Technische Hochschule, Aachen (Germany, F.R.). Fakultaet fuer Bauingenieur- und Vermessungswesen.
THE CALCULATION OF THE ULTIMATE CAPACITY OF A ONE RUNWAY MAIN SYSTEM. A NEW ARRANGEMENT ON THE BASIS OF A RADAR DATA EVALUATION Ph.D. Thesis [DIE BERECHNUNG DER GRENZKAPAZITAET EINES 'ONE-RUNWAY-MAIN SYSTEM': EIN NEUER ANSATZ AUF DER BASIS EINER RADARDATENAUSWERTUNG]
Ralf Chaumet 1989 192 p In GERMAN; ENGLISH summary
(ETN-90-98189) Avail: NTIS HC/MF A09

The basis for the arrivals-only model and for the determination of time deviations from model flight arrival characteristics, is the evaluation of radar data. This data, which reveal in synchronized

form all simultaneous air traffic movements in the vicinity of the airport captured by radar, are turned into individual flight profiles and flight sequences. Using algorithms, the radar signals which display location altitude and time are determined, and through the use of compensating computations, the overflight time points and speeds are extracted. The results of the radar data analysis enter into the model for estimating the ultimate capacity. In order to help in the application of this model to other runway systems, the various factors that influence the ultimate capacity are given.
ESA

N91-12567# Wichita State Univ., KS. Inst. for Aviation Research.
THE ENHANCEMENT OF AIR TRAFFIC CONTROL SAFETY THROUGH PRE-HIRE UNIVERSITY BASED TRAINING PROGRAMS
Brent D. Bowen *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 82-107 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12577# Federal Aviation Administration, Atlantic City, NJ.
GENERAL AVIATION AND TCAS
Carl B. Jezierski *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 358-363 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12701*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FLIGHT TEST RESULTS OF FAILURE DETECTION AND ISOLATION ALGORITHMS FOR A REDUNDANT STRAPDOWN INERTIAL MEASUREMENT UNIT
F. R. Morrell, P. R. Motyka, and M. L. Bailey (PRC Kentron, Inc., Hampton, VA.) *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 13 p (For primary document see N91-12682 04-08)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive
CSCL 17G

N91-12704# Crouzet Aerospace and Systems, Valence (France).
A HIGH INTEGRITY FLIGHT DATA SYSTEM
J. L. Roch and J. Contet *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 10 p In FRENCH (For primary document see N91-12682 04-08)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation*.

N91-12661*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
HYPERSONIC AIRCRAFT DESIGN Final Report
Hani Alkamhawi, Tom Greiner, Gerry Fuerst, Shawn Luich, Bob Stonebraker, and Todd Wray May 1990 174 p Prepared in cooperation with Universities Space Research Association, Houston, TX Sponsored by NASA
(RF Proj. 767919/722941)
(NASA-CR-187008; NAS 1.26:187008) Avail: NTIS HC/MF A08 CSCL 01C

A hypersonic aircraft is designed which uses scramjets to accelerate from Mach 6 to Mach 10 and sustain that speed for two minutes. Different propulsion systems were considered and it was decided that the aircraft would use one full scale turbofan-ramjet. Two solid rocket boosters were added to save fuel and help the aircraft pass through the transonic region. After considering aerodynamics, aircraft design, stability and control, cooling systems, mission profile, and landing systems, a conventional aircraft configuration was chosen over that of a waverider. The conventional design was chosen due to its landing characteristics and the relative expense compared to the waverider. Fuel requirements and the integration of the engine systems and their inlets are also taken into consideration in the final design. A hypersonic aircraft was designed which uses scramjets to accelerate from Mach 6 to Mach 10 and sustain that speed for two minutes. Different propulsion systems were considered and a full scale turbofan-ramjet was chosen. Two solid rocket boosters were added to save fuel and help the aircraft pass through the transonic reqion. After the aerodynamics, aircraft design, stability and control, cooling systems, mission profile, landing systems, and their physical interactions were considered, a conventional aircraft configuration was chosen over that of a waverider. The conventional design was chosen due to its landing characteristics and the relative expense compared to the waverider. Fuel requirements and the integration of the engine systems and their inlets were also considered in the designing process. Author

N91-12662*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
STB-WHITE Final Report
Dan Molnar, Rob Ammon, Todd Gallagher, Pat Gouhin, Steve Hermann, John Bryan Roos, Craig Saurer, and Heather White May 1990 167 p Prepared in cooperation with Universities Space Research Association, Houston, TX Sponsored by NASA (NASA-CR-187012; NAS 1.26:187012) Avail: NTIS HC/MF A08 CSCL 01C

The final design of a hypersonic, SCRAMjet research aircraft, which is to be dropped from a carrier plane, is considered. Topics such as propulsion systems, aerodynamics, component weight analysis, and aircraft design with waverider analyses are stressed with smaller emphasis placed on aircraft systems such as cockpit design and landing gear configurations. Propulsion systems include analysis of the turbofanramjet for acceleration to low hypersonic speed (Mach 6.0) and analysis of the SCRAMjets themselves to carry the aircraft to Mach 10.0. Both analyses include the use of liquid hydrogen as fuel. Inlet design for both propulsion systems is analyzed as well. Aerodynamic properties are found using empirical and theoretical formulas for lift and drag on delta-wing aircraft. The aircraft design involves the integration of all preliminary studies into a modified waverider configuration. Author

N91-12663 ESDU International Ltd., London (England).
PITCHING MOMENT AND LIFT FORCE DERIVATIVES DUE TO RATE OF PITCH FOR AIRCRAFT AT SUBSONIC SPEEDS
Abstract Only
Jul. 1990 45 p
(ESDU-90010; ISBN-0-85679-736-7; ISSN-0141-397X) Avail: ESDU

ESDU 90010 provides a method that applies to a rigid aircraft at low angles of attack and relies on summing the separate contributions of the body, wing, and tailplane with an allowance for the interference effect of the body on the wing. The body contribution to the pitching moment derivative is calculated from a semi-empirical equation in which the body lift-curve slope from slender body theory is modified for body fineness ratio, afterbody geometry, and its cross-section shape. The body contribution to the lift derivative is negligible. For the wing contribution to both derivatives, strip theory is also modified empirically for straight-tapered wings while for delta and cropped-delta wings it is found that data derived from Multhopp's lifting-line theory can be applied directly. Other wing planforms are converted to straight-tapered through the equivalent wing concept of ESDU 76003. The tailplane contribution is found most-closely to match the available data if it is treated as an isolated surface (with

lift-curve slope derived from ESDU 70011). The body interference on the wing is accounted for by the use of the gross planform and a shift in aerodynamic center position for the body carry-over lift. The accuracy of the predictions is discussed, and sketches of experimental results plotted against predictions are given for the moment derivative, for body and wing alone and for wing-body combinations. Two worked examples, one for a typical transport configuration and one for a typical interceptor aircraft, illustrate the use of the methods. ESDU

N91-12664# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.
MBB BO 108 HELICOPTER GROUND AND FLIGHT TEST EVALUATION
D. Schimke, B. Enenkl, and E. Allramseder Dec. 1989 21 p Presented at 15th European Rotorcraft Forum, Amsterdam, Netherlands, 12-15 Sep. 1989
(MBB-UD-0546-89-PUB; ETN-90-97854) Avail: NTIS HC/MF A03

The particular design features and an overview of the successful ground and flight testing of MBB (Messerschmitt-Boelkow-Blohm) the BO 108 flight twin engine helicopter, designed for integrating new technologies into the next generation of helicopters are described. Technology innovations include the composite bearingless main rotor system, new aerodynamic blade design, tail rotor with elastomeric bearings, composite structures, anti-resonance vibration isolation system, electrical and avionic systems, new gearbox design, and engine integration. These components were tested and evaluated separately and mounted in the prototype. The ground test evaluation contained aeroelastic stability on the whirl tower, shake tests of the fuselage, and ground resonance tests. The main items of the flight test were air resonance stability, loads, flight performance, handling qualities, and the flight envelope survey. Besides verifying the new technologies, the flight behavior of the new helicopter was rated as excellent by the pilots and flight test analysis confirmed the expected performances. ESA

N91-12665# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
AN INVESTIGATION OF AIRCRAFT MANEUVERABILITY AND AGILITY Final Report, Jun. 1989 - May 1990 M.S. Thesis
Frederick W. Stellar 17 May 1990 77 p
(AD-A224587) Avail: NTIS HC/MF A05 CSCL 01/3

Improved effectiveness of close air support (CAS) aircraft has increased counter-air developments and the possibility of air-to-air combat (ATAC). Maneuverability and agility are desired attributes of CAS aircraft which must operate close to terrain or engage in air combat. The objective was to investigate maneuverability and agility of modern CAS aircraft. The investigation was accomplished by expanding the capabilities of HELCOM to incorporate fixed wing aircraft modeling. HELCOM is a series of computer programs which use energy/force balancing methods to determine maneuverability and agility parameters. Joint Air Attack Team (JAAT), integrating OH-58D, AH-64A, and A-10A aircraft, served as the CAS air force for investigating maneuverability and agility. HELCOM, as a tool for understanding maneuverability and agility, was improved to provide a good approximation for both rotary wing and fixed wing aircraft. Tilt-rotor aircraft concept was compared to current CAS aircraft and shown to incorporate design features desired in highly maneuverable and agile aircraft. GRA

N91-12666# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Information und Dokumentation.
ANALYTICAL METHODS FOR THE QUALIFICATION OF HELICOPTER STRUCTURES
Fritz Och Apr. 1990 16 p Presented at the 70th Agard Structures and Materials Panel Meeting and Workshop on Analytical Qualification of Aircraft Structures, Sorrento, Italy, 1-6 Apr. 1990
(MBB-UD-0569-90-PUB; ETN-90-97839) Copyright Avail: NTIS HC/MF A03

During the development of composite fuselage for the BK 117, both an analytical and an experimental strength substantiation was performed, which corresponded very well and formed the basis for airworthiness qualification of this experimental helicopter under flight testing now. A large number of components in the dynamic system are designed primarily so that they will provide adequate fatigue strength, defined in terms of an endurance limit, or in terms of fatigue life. The analytical qualification of these fatigue critical structures, on the basis of measured fatigue loadings and calculated working S-N curves, is state of the art in the helicopter industry. In the nonlinear domain, analytical methods were applied for highly limitated elastomeric bearings and for the crashworthiness qualification of both crushable subcomponents and complete helicopters. The results gained allow the application of analytical methods, partly in combination with coupon or component testing, for the qualification or helicopter structures. ESA

N91-12667# Technion - Israel Inst. of Tech., Haifa. Jet Propulsion Lab.
NOVEL, POST-STALL, THRUST-VECTORED F-15 RPVS: LABORATORY AND FLIGHT TESTS Annual Report No. 1, 1 Apr. 1989 - 31 Mar. 1990
Benjamin Gal-Or 24 Apr. 1990 188 p
(Contract MIPR-FY1456-8905052; AF-AFOSR-0445-89)
(AD-A225717; TAE-160-0559) Avail: NTIS HC/MF A09 CSCL 01/3

Presenting the major problems confronting the development, tests, and validation of Post STall (PST) Thrust Vectored Fighters (TVF), this project is based on the development of an integrated laboratory flight testing methodology of PST-F-15-TVF/RPVs, including the tests of new types of yaw-pitch and roll-yaw pitch thrust vectoring nozzles and high alpha, PST inlets. GRA

N91-12668# Federal Aviation Administration, Long Beach, CA.
REPAIRS TO DAMAGE TOLERANT AIRCRAFT
T. Swift 22 Mar. 1990 25 p Presented at the International Symposium on Structural Integrity of Aging Airplanes, Atlanta, GA
(AD-A225742) Avail: NTIS HC/MF A03 CSCL 01/3

Results of displacement compatibility analysis, representing a variety of repair doubler and lap splice configurations, are presented to illustrate how structural repairs can degrade the fatigue initiation life and damage tolerance capability of primary transport aircraft structures. Examples show that fatigue initiation life is directly related to the peak loads induced in the first fastener rows at the edges of repair doublers. Design of repairs to an equal or better static strength capability and the associated static strength analysis will not normally highlight these peak loads which can result in considerable degradation of structural fatigue life. Critical fastener loads, based on displacement compatibility analysis accounting for fastener flexibility, are parametrically presented for a variety of skin and doubler thicknesses. Suggestions are made on how repair designs can be modified to improve fatigue initiation life and subsequent fatigue crack detectability particularly in the event of multiple-site damage. The importance of riveting quality during repairs, often not up to initial manufacturing standards, is discussed with respect to fatigue initiation life. A simplified but conservative method to generate crack growth curves is discussed with a view to easing the analytical burden for the small modifiers. GRA

N91-12669# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
ACMS: A PROTOTYPE EXPERT DATABASE FOR AIR COMBAT MANEUVERING M.S. Thesis
Rodrick William Lekey Mar. 1990 83 p
(AD-A225774) Avail: NTIS HC/MF A05 CSCL 01/2

In combat situations, a fighter pilot must deal with a large number of input variables and decision alternatives in a very short time. To have the greatest chance of success in an encounter, the pilot must have a viable game plan in mind before he engages with an enemy aircraft. This game plan comes about through many hours of expert training in various scenarios of actual and hypothetical situations. This study describes the design and implementation of a prototype expert database training system for air combat maneuvering. The architecture of the system integrates a rule-based expert system with a database in a loosely coupled

fashion. The expert system component of the system uses its rule base, access to the database, and the pilot input to arrive at its decision. GRA

N91-12670# Lawrence Livermore National Lab., CA.
SUPERPRESSURE STRATOSPHERIC VEHICLE Final Report
C. Chocol, W. Robinson, and L. Epley 15 Sep. 1990 135 p
(Contract W-7405-eng-48; ARPA Order 6874)
(DE91-000496; UCRL-ID-105097) Avail: NTIS HC/MF A07

Our need for wide-band global communications, earth imaging and sensing, atmospheric measurements and military reconnaissance is extensive, but growing dependence on space-based systems raises concerns about vulnerability. Military commanders require space assets that are more accessible and under local control. As a result, a robust and low cost access to space-like capability has become a national priority. Free floating buoyant vehicles in the middle stratosphere can provide the kind of cost effective access to space-like capability needed for a variety of missions. These vehicles are inexpensive, invisible, and easily launched. Developments in payload electronics, atmospheric modeling, and materials combined with improving communications and navigation infrastructure are making balloon-borne concepts more attractive. The important milestone accomplished by this project was the planned test flight over the continental United States. This document is specifically intended to review the technology development and preparations leading up to the test flight. Although the test flight experienced a payload failure just before entering its assent altitude, significant data were gathered. The results of the test flight are presented here. Important factors included in this report include quality assurance testing of the balloon, payload definition and characteristics, systems integration, preflight testing procedures, range operations, data collection, and post-flight analysis. DOE

N91-12671# Oak Ridge National Lab., TN.
COMMERCIAL AIRCRAFT FUEL EFFICIENCY POTENTIAL THROUGH 2010
David L. Greene 1990 7 p Presented at the 25th Intersociety Energy Conversion Engineering Conference, Reno, NV, 12-17 Aug. 1990
(Contract DE-AC05-84OR-21400)
(DE91-000720; CONF-900801-34) Avail: NTIS HC/MF A02

Aircraft are second only to motor vehicles in the use of motor fuels, and air travel is growing twice as fast. Since 1970 air travel has more than tripled, but the growth of fuel use has been restrained by a near doubling of efficiency, from 26.2 seat miles per gallon (SMPG) in 1970 to about 49 SMPG in 1989. This paper explores the potential for future efficiency improvements via the replacement of existing aircraft with '1990's generation' and 'post 2000' aircraft incorporating advances in engine and airframe technology. Today, new commercial passenger aircraft deliver 50 to 70 SMPG. New aircraft types scheduled for delivery in the early 1990's are expected to achieve 65 to 80 SMPG. Industry and government researchers have identified technologies capable of boosting aircraft efficiencies to the 100 to 150 SMPG range. Under current industry plans, which do not include a post-2000 generation of new aircraft, the total aircraft fleet should reach the vicinity of 65 SMPG by 2010. A new generation of 100 to 150 SMPG aircraft introduced in 2005 could raise the fleet average efficiency to 75 to 80 SMPG in 2010. In any case, fuel use will likely continue to grow at from 1 to 2 percent per yr. through 2010. DOE

N91-12672# Naval Aerospace Medical Research Lab., Pensacola, FL.
SUSTAINED FLIGHT OPERATIONS IN NAVY P-3 AIRCRAFT Final Report
L. G. Meyer and C. A. DeJohn Apr. 1990 27 p Sponsored by Naval Medical Research and Development Command, Bethesda, MD
(AD-A226412; NAMRL-1355) Avail: NTIS HC/MF A03 CSCL 06/10

Flight crew fatigue during sustained flight operations (SUSOPS) is an important aeromedical problem. We evaluated the effects of SUSOPS on aircrew stress and fatigue in three U.S. Navy P-3 Orion crews (n = 21) before, during, and after a 6-month overseas deployment. Pre- and postdeployment laboratory tests measured aerobic capacity, pulmonary function, muscular strength and endurance, and resting blood chemistry. Postdeployment lung capacity, blood chemistry values, grip strength, and leg endurance all improved while leg strength, aerobic capacity, and percentage body fat decreased. During deployment, we collected inflight urine samples and subjective fatigue and positive/negative mood surveys hourly. Urinary sodium and potassium levels were significantly higher inflight compared to postdeployment control values. Urinary norepinephrine concentrations inflight were lower compared to controls. Subjective-fatigue scores decreased from preflight to postflight. Positive mood scores decreased while negative mood scores increased. Subjects showed varying levels of stress and fatigue, which did not appear to compromise performance and safety. The 15-h nonflying intervals between flights provided sufficient rest for the crews. GRA

N91-12673# Rockwell International Corp., Los Angeles, CA.
SUPERPLASTIC FORMED ALUMINUM-LITHIUM AIRCRAFT STRUCTURES Final Report, May 1988 - Jul. 1989
C. E. Anton and G. R. Martin Jun. 1990 396 p
(Contract F33615-87-C-3223; AF Proj. 2401)
(AD-A226516; N4-89-1361L; WRDC-TR-89-3015) Avail: NTIS HC/MF A17 CSCL 11/6

This final report contains the results of Phase 2 of this two phase program which is primarily concerned with technology demonstration. The report begins with the submission of three advanced superplastic formed (SPF) designs; a floor support beam, keelson shear panel and a forward fuselage bulkhead. A detailed Weight and Life Cycle cost (LCC) trade study was done on each of these. The LCC study showed a cost savings of $14.8 million for the floor support beam, a $5.01 million savings for the keelson shear panel and a $7.8 million cost increase for the forward bulkhead (this was attributed to design complexity). The weight savings study showed a weight savings for the floor support beam and keelson shear panel (7.05 lbs and 2.57 lbs) and a weight penalty of 3.85 lbs for the forward bulkhead. The durability and damage tolerance analysis of the floor support beam resulted in a durability life of 63,650 cycles and a damage tolerant life of 34,000 cycles. Strength data results from the solution heat treatment optimization confirmed that longer solution heat treatment intervals did not increase the strength properties of the 8091 Al-Li material. GRA

N91-12674# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
TWELFTH PLANTEMA MEMORIAL LECTURE ON ASSESSMENT OF SERVICE LOAD EXPERIENCE
J. B. deJonge 10 Mar. 1990 46 p Presented at 15th ICAF Symposium, Jerusalem, Israel, Jun. 1989
(NLR-TP-89097-U; ETN-90-98057) Avail: NTIS HC/MF A03

A review of the various types of loading acting on the aircraft structure and the ability to accurately predict their magnitude and frequency of occurrence for a given aircraft usage is presented. Attention is paid to the variation in load experience and its causes, with specific reference to the variation in aircraft usage. For transport type aircraft these variations are largely defined by the variation in flight length and payload. For combat type aircraft, the variability is considerably larger and consequently more difficult. For the assessment of actual service load spectra, operational flight load measurements and/or service usage monitoring are required. The rapid development of electronics during the last decades has opened the possibility for advanced processor based service fatigue load monitoring systems at relatively low price. For transport aircraft simple usage monitoring may already provide highly relevant information. For combat type aircraft, the determination of average mission type spectra from in flight multiparameter recordings, in combination with mission usage monitoring for individual airplane tracking appears to be an adequate solution. ESA

N91-12675# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
RE-ASSESSING THE F-16 DAMAGE TOLERANCE AND DURABILITY LIFE OF THE RNLAF F-16 AIRCRAFT
D. J. Spiekhout 9 Jun. 1990 26 p Presented at 15th ICAF Symposium, Jerusalem, Israel, Jun. 1989 Previously announced in IAA as A90-49881
(NLR-TP-89184-U; ETN-90-98058) Avail: NTIS HC/MF A03

Usage and loading experience of the RNLAF (Royal Netherlands Air Force) with their F-16 aircraft is completely different from the ones assumed in the design phase. Reassessment of the damage tolerance and durability performance was therefore carried out. A contribution to this is presented. It is concluded that it is of great importance for a relatively small airforce such as RNLAF to follow such a damage tolerance and durability life reassessment very closely. The risks involved in making general assumptions in such an international program covering all sorts of usages is shown to be real. ESA

N91-12676# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Hubschrauber und Flugzeuge.
THIRTY YEARS OF STRUCTURAL DYNAMIC INVESTIGATIONS AT MBB-UF
Otto Sensburg 7 May 1990 46 p
(MBB/FE2/S/PUB/0399; ETN-90-98155) Copyright Avail: NTIS HC/MF A03

The tests and developments which enabled the German aircraft industry to become competitive again with other leading nations are summarized. During the last 30 years a revolution in the development of airplanes and helicopters has taken place. The introduction of microelectronic flight control systems has given the possibility to control loads and vibrations actively. New composite materials allow us tailoring of the elasticity of surfaces in a way to fulfill the requirements of strength, deformation and flutter with minimum structural weight. On the other side there is no more redundant inherent structural stiffness found as on metal structures and there is a large possibility of aeroservoelastic instability due to fast responding hydraulic actuators. Therefore the prediction of unsteady airforces, the measurement of these forces on wind tunnel models and the updating of analytical models with measured data is even more important now than it was 30 years ago. ESA

N91-12574# Honeywell, Inc., Glendale, AZ. Commercial Flight Systems Group.
GULFSTREAM 4 FLIGHT MANAGEMENT SYSTEM
Steven C. Runo *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 312-329 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12575# Beech Aircraft Corp., Wichita, KS.
DESIGN AND CERTIFICATION OF AIRCRAFT FOR THE HERF ENVIRONMENT
Jack Glecier and Joseph P. Cross *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 330-347 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12689*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE INTEGRATED AIRFRAME/PROPULSION CONTROL SYSTEM ARCHITECTURE PROGRAM (IAPSA)
Daniel L. Palumbo, Gerald C. Cohen (Boeing Advanced Systems Co., Seattle, WA.), and Charles W. Meissner *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 5 p (For primary document see N91-12682 04-08)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive CSCL 01C

N91-13314*# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
NATURAL LAMINAR FLOW APPLICATION TO TRANSPORT AIRCRAFT
Louis B. Gratzer *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 50-51 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 01C

N91-13333*# Military Academy, West Point, NY. Dept. of Aerospace Engineering.
CALCULATION OF ROTOR IMPEDANCE FOR USE IN DESIGN ANALYSIS OF HELICOPTER AIRFRAME VIBRATIONS
Kip P. Nygren *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 91-92 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 01C

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N91-12677*# Lockheed Aeronautical Systems Co., Marietta, GA.
DIVERTER DECISION AIDING FOR IN-FLIGHT DIVERSIONS Final Report
Frederick M. Rudolph, David A. Homoki, and George A. Sexton Aug. 1990 323 p Original contains color illustrations
(Contract NAS1-18029)
(NASA-CR-182070; NAS 1.26:182070; LG90ER0040) Avail: NTIS HC/MF A14; 3 functional color pages CSCL 01D

It was determined that artificial intelligence technology can provide pilots with the help they need in making the complex decisions concerning en route changes in a flight plan. A diverter system should have the capability to take all of the available information and produce a recommendation to the pilot. Phase three illustrated that using Joshua to develop rules for an expert system and a Statice database provided additional flexibility by permitting the development of dynamic weighting of diversion relevant parameters. This increases the fidelity of the AI functions cited as useful in aiding the pilot to perform situational assessment, navigation rerouting, flight planning/replanning, and maneuver execution. Additionally, a prototype pilot-vehicle interface (PVI) was designed providing for the integration of both text and graphical based information. Advanced technologies were applied to PVI design, resulting in a hierarchical menu based architecture to increase the efficiency of information transfer while reducing expected workload. Additional efficiency was gained by integrating spatial and text displays into an integrated user interface. Author

N91-12678# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Hubschrauber und Flugzeuge.
THE THREAT MANAGEMENT FOR A MODERN FIGHTER [BEDROHUNGSMANAGEMENT FUER EIN MODERNES KAMPFFLUGZEUG]
Holla Apr. 1990 14 p In GERMAN Prepared in cooperation with Texas Instruments Deutschland G.m.b.H., Freising, Fed. Republic of Germany
(MBB/FE300/S/PUB/347; ETN-90-97844) Copyright Avail: NTIS HC/MF A03

The use of an expert system on the basis of sensor fusion for the threat management of a modern fighter is described. The essential aim is to increase the survivability and the offensive capacity of the aircraft. This can be obtained through improving the threat management and developing a tactical counsellor, in order to help the crew. A sensor fusion system and a knowledge based system for a tactical counsellor are developed. The

described multiphase project secures a development which avoids unnecessary risks. The single phases produce proof that the currently available technology of expert systems and the existing algorithms for the fusion of sensors guarantee a successful conclusion of the cooperation project. ESA

N91-12679# Operational Test and Evaluation Force, Norfolk, VA.
FOLLOW-ON OPERATIONAL TEST AND EVALUATION OF THE CPU-152/A STANDARD CENTRAL AIR DATA COMPUTER (SCADC) Report, 1-20 Jul. 1990
21 Aug. 1990 5 p
(AD-A226310) Avail: NTIS HC/MF A01 CSCL 12/6

The purpose of the evaluation was to verify that all the deficiencies from OT-IIC OPEVAL has been corrected prior to approval for full fleet introduction. The evaluation was based on the results of non-scenario operational tests conducted under Project M756, supplemented by the results of OPEVAL, developmental testing, and operational experience. Based on this evaluation, the CPU-152/A SCADC as installed in the S-3A/B aircraft is determined to be operationally effective and operationally suitable. Approval for full fleet introduction of the CPU-152/A is recommended. The SCADC uses air pressure from the pitot static system and temperature signals from the temperature probe to provide air data outputs for navigation, cockpit display, sonobuoy and weapon delivery systems, Automatic Flight Control System (AFCS), and altitude reporting. While the digital SCADC is a form, fit, and function replacement for the existing S-3 Airspeed Altitude Computer Set (AACS), it has, in addition, a Built-in-test (BIT) function allowing maintenance personnel to determine system status without removing the unit. GRA

N91-12680# Boeing Military Airplane Development, Seattle, WA.
3-D IMAGERY COCKPIT DISPLAY DEVELOPMENT Final Report, Oct. 1986 - Feb. 1989
T. C. Way, R. E. Hobbs, J. Qualy-White, and J. D. Gilmour Aug. 1990 170 p
(Contract F33615-86-C-3601; AF Proj. 2403)
(AD-A226411; WRDC-TR-90-7003) Avail: NTIS HC/MF A08 CSCL 01/4

The 3-D Imagery Cockpit Display Development Program was designed to evaluate the potential payoff in situation awareness of adding retinal disparity (3-D) to pictorial formats for use in advanced aircraft and to advance the evolution of the pictorial formats themselves. The study consisted of designing the formats, evaluation of formats in part-task, part-mission, and full-mission simulation, and redesigning formats based on air crew feedback if needed. GRA

N91-12576# Federal Aviation Administration, Atlantic City, NJ.
THE FAA TECHNICAL CENTER'S AVIONICS DATA LINK INITIATIVE
Albert J. Rehmann *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 348-357 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12686# Draper (Charles Stark) Lab., Inc., Cambridge, MA. Fault-Tolerant Systems Div.
TECHNIQUES FOR TRANSIENT ERROR RECOVERY AND AVOIDANCE IN REDUNDANT PROCESSING SYSTEMS
Stuart Adams and Mark Dzwonczyk *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 9 p (For primary document see N91-12682 04-08)
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N91-12698# Crouzet Aerospace and Systems, Valence (France).
BREAKDOWN METHODOLOGY FOR FLIGHT CRITICAL APPLICATIONS INTO ELEMENTARY COMPONENTS
Bernard Chavana and Francois deSainteMaresville *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 9 p In FRENCH (For primary document see N91-12682 04-08)
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07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N91-12681# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
EXPERIMENTAL RESEARCH ON DIGITAL CONTROL OF ENGINE JT15D-4
Rei Ma, Dazhong Jinang, Yuanye Li, and Huacong Le 19 Jun. 1990 7 p Transl. into ENGLISH from Acta Aeronautica et Astronautica Sinica (Peoples Republic of China), v. 10, no. 6, Jun. 1989 p 272-274
(AD-A225342; FTD-ID(RS)T-0242-90) Avail: NTIS HC/MF A02 CSCL 21/5

This study carried out experimental research on digital control systems for the JT15D-4 engine. It probed into problems associated with the design and operation of digital control systems. In order to raise the reliability of digital control in the systems, we selected for use duplex communications, condition performance monitoring, hydraulic mechanism reserve regulators, software malfunction diagnosis alarm, and other similar types of measures. Going through digital simulation, semi-physical simulations, and various phases of actual operation on test platforms, the correctness of the system structure and design were experimentally verified, and this supplied experience in actual use for research on a more advanced development of full-function digital control. GRA

N91-12528# Tokyo Univ. (Japan). Dept. of Aeronautics.
NUMERICAL ANALYSIS OF FLOW IN A SCRAMJET ENGINE
Tetsuya Sato and Shojiro Kaji *In* NAL, Proceedings of the 7th NAL Synposium on Aircraft Computational Aerodynamics 1989 p 93-97 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12529# National Aerospace Lab., Tokyo (Japan).
NUMERICAL COMPUTATION OF FLOW FOR SCRAMJET
Tomiko Ishiguro, Satoru Ogawa, and Yasuhiro Wada *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 99-104 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12534# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
AEROTHERMAL ANALYSIS FOR GAS TURBINE COMBUSTION LINER COOLING SLOTS
Hidemi Toh, Yukinori Sato, Yasunori Ando, and Masafumi Kawai *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 129-134 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12537# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF THE FLOWFIELD THROUGH A TURBINE BLADE ROW WITH TIP CLEARANCE
Osamu Nozaki, Atsuhiro Tamura, Toshinori Watanabe, and Isao Kanazawa (National Space Development Agency, Tokyo, Japan)

In its Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 147-154 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12569# John Deere Technologies International, Inc., Wood-Ridge, NJ.
ADVANCED STRATIFIED CHARGE ROTARY ENGINE TECHNOLOGY FOR GENERAL AVIATION SYSTEMS
Robert S. Mount and Edward S. Wright *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Avaiation Systems May 1990 p 202-221 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12595# Nissan Motor Co. Ltd., Tokyo (Japan).
NUMERICAL SIMULATIONS OF THE FLOW FIELD IN A SCRAM JET ENGINE COMBUSTOR
Kenichi Hirai *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 21-26 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12628# National Aerospace Lab., Tokyo (Japan).
DESIGN OF ULTRA HIGH BYPASS FAN WITH NUMERICAL SOLUTION OF NAVIER-STOKES EQUATIONS
Osamu Nozaki, Yoshio Saito, Atsuhiro Tamura, and Kazuhiro Nakahashi (Osaka Univ., Suita, Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 249-255 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N91-12682# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.
FAULT TOLERANT DESIGN CONCEPTS FOR HIGHLY INTEGRATED FLIGHT CRITICAL GUIDANCE AND CONTROL SYSTEMS
Apr. 1990 263 p In ENGLISH and FRENCH The 49th symposium was held in Toulouse, France, 10-13 Oct. 1989 (AGARD-CP-456; ISBN-92-835-0552-2) Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Papers presented covered the following topics: trends in integrated flight critical systems; advanced fault tolerant design concepts; system architectures, mechanization and integration issues; high integrity software design methodologies and algorithms; and system validation, simulation and flight test experience. For individual titles, see N91-12683 through N91-12704.

N91-12683# General Dynamics/Fort Worth, TX.
FLIGHT CRITICAL DESIGN CONCEPTS FOR LOW-LEVEL TACTICAL GUIDANCE AND CONTROL
Michael R. Griswold *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 8 p (For primary document see N91-12682 04-08)
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Low-level combat operations, such as might be typified by next generation close air support (CAS) aircraft, present new demands on the guidance and control system. The design must address not only the traditional flight-critical definitions related to system management, ground collision avoidance, and operational flight restrictions, but also the possibility of increased exposure to defensive countermeasures due to system failure. It is also clear that traditional guidance and control methods must be re-examined in light of total mission goals. For instance, employing an active sensor to aid in terrain avoidance may decrease overall combat survivability due to increased detectability by threats. Several of the elements of flight critical concepts are presented for low-level tactical operation. This includes classical elements as well as mission-specific considerations such as threat exposure and threat evasion. In both cases, system failure may compromise safety. The mission scenario for the discussions is the CAS mission using a fast moving, technologically advanced aircraft. The guidance and control strategies for the proposed application are discussed with emphasis on system integrity considerations and performance-versus-safety-issues. Terrain verification is a critical process for low-level operation when the digital terrain database is utilized for fundamental guidance and control information. Fault detection and management schemes are also examined. The application of previously developed system-wide integrity management design philosophies are considered for subsystem integrity monitoring and communications. These techniques are reviewed with an eye toward analytical and inductive redundancy techniques to achieve acceptable levels of detection without resorting to physical redundancy. Author

N91-12684# Aerospatiale, Toulouse (France).
CIVIL APPLICATIONS TRENDS
Pascal Traverse *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 17 p In FRENCH (For primary document see N91-12682 04-08)
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Flight control of Airbus A320 marked a stage in the history of aeronautics as well as in the history of fault tolerant information systems. This control system is examined along with its possible evolution. This evolution is detailed, especially the architecture of the computer, the architecture of the information system, use in optics, and the design of the systems. E.R.

N91-12685# Ferranti Defence Systems Ltd., Edinburgh (Scotland).
PILOT MONITORING OF DISPLAY ENHANCEMENTS GENERATED FROM A DIGITAL DATA BASE **c54**
Peter J. Bennett and John J. Cockburn *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 7 p (For primary document see N91-12682 04-08)
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A Ferranti International integrated covert mission system called PENETRATE (Passive Enhanced Navigation with Terrain Referenced Avionics) is currently undergoing flight trials on a Hunter fast-jet aircraft at the Royal Aerospace Establishment. The heart of the PENETRATE system is a digital data store housing a three dimensional model of the terrain including cultural details and tactical intelligence information. This integrated mass memory store supplies data to a Terrain Referenced Navigation System, a head-down digital map and a head-up Skeletal Perspective Terrain Image Generator. The integrity of the terrain data loaded into this covert system cannot be totally guaranteed; neither can the navigation accuracy. The pilot must, therefore, use his normal visual technique to monitor the synthetic terrain displays for acceptable correlation with the real world. The PENETRATE integrated covert mission system, the increase in operational capability it provides, and the visual monitoring requirements are described. Author

N91-12686# Draper (Charles Stark) Lab., Inc., Cambridge, MA. Fault-Tolerant Systems Div.

TECHNIQUES FOR TRANSIENT ERROR RECOVERY AND AVOIDANCE IN REDUNDANT PROCESSING SYSTEMS **c06**

Stuart Adams and Mark Dzwonczyk *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 9 p (For primary document see N91-12682 04-08)

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As the trend for increased storage in reliable, high-performance guidance, navigation, and control systems continues, coverage of transient memory failures becomes an increasingly critical problem. New techniques of recovery from such failures are discussed in redundant processing systems which perform high-frequency iterative control algorithms for flight critical GN and C. Two approaches are presented. The first employs hardware assisted recovery techniques to detect which memory segments in the failed processor need to be restored, so that recovery can be accomplished incrementally, by only restoring segments of memory which were corrupted. The second approach is to utilize a common fault-tolerant memory which allows errors to be masked and corrected on-the-fly eliminating the need for recovery. Author

N91-12687# Draper (Charles Stark) Lab., Inc., Cambridge, MA.

THE ROLE OF TIME-LIMITED DISPATCH OPERATION IN FAULT-TOLERANT FLIGHT CRITICAL CONTROL SYSTEMS

Deborah F. Allinger, Frank J. Leong, Philip S. Babcock, IV, Richard F. LaPrad, and Gary C. Horan (Pratt and Whitney Aircraft, East Hartford, CT.) *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 12 p (For primary document see N91-12682 04-08)

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The use of fault-tolerant system design concepts to achieve otherwise unattainable levels of reliability in modern flight critical control systems is rapidly becoming commonplace. Fault-tolerant flight and propulsion control systems, for example, are now being deployed in modern aircraft, spacecraft, and submersibles. The characteristics of these systems pose new problems for the designers of such systems and afford new opportunities for their users. A basic motivation for introducing fault tolerance is to be able to preserve some level of functionality of the system in the wake of failures of some of the system's components. This property of fault-tolerant systems affords an opportunity to dispatch these systems with failed components for a limited time period. This mode of operation is referred to as time-limited dispatch. In time-limited dispatch operation, benefits related to both maintenance and operations can be realized. Aircraft maintenance actions can be deferred until a more convenient time or place, for example. Similarly, the sortie rates that can be realized in tactical situations can be increased. In order to determine optimal or near optimal dispatch policies for fault-tolerant systems, one must have a systematic means of establishing dispatch policies and be able to quantify the benefits that can be realized by adopting specific dispatch policies. A tractable methodology for doing so is described and illustrated. Author

N91-12688# GEC Avionics Ltd., Rochester (England). Flight Control Div.

A FAULT TOLERANT FLY BY WIRE SYSTEM FOR MAINTENANCE FREE APPLICATIONS

R. W. Dennis and A. D. Hills *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 14 p (For primary document see N91-12682 04-08)

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A triplex primary flight computer system based on a reconfigurable architecture with extensive use of Application Specific Integrated Circuits (ASIC) is described. The system is under development and comprises fault tolerant Fly-by-Wire (FBW) computers which are triplex dissimilar in both software and hardware. These command Actuator Control Electronics (ACE) units via DATAC (ARINC 629) data buses. The Fly-by-Wire computers form the core of the full authority FBW system and perform all the computational commands for the pitch, roll and yaw surface actuation systems. The key requirements placed on the FBW computers are: the probability of loss of the FBW function due to random failure in the FBW computer system shall be less than 1.0E-10; the FBW system shall survive a generic failure which could arise from either hardware or software; and the system reliability shall have a design aim of 0.95 dispatch probability after at least 30,000 operating hours. The architectural design issues, in terms of integrity requirements and fault tolerance, are reviewed. The FBW computer architecture is based on dividing the basic path into three sub-functional elements. Each of these elements is then replicated to provide fault tolerance. Communication between any one element and its adjacent elements is via point to point bidirectional serial data buses. For a FBW computer to be operable only one of each element type needs to be functional. The internal element redundancy management function, performed both in hardware and software, is able to detect and isolate faulty elements and perform the necessary reconfiguration. Redundancy management is also addressed from a system viewpoint together with the implementation in terms of both hardware and software. The development hardware produced is described. The software structure and the use of dissimilarity is also addressed. The Fly-by-Wire system is being evaluated using an iron bird rig in which FBW computers, DATAC buses, Actuator Control Electronics, and actuators were installed. Author

N91-12689*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

THE INTEGRATED AIRFRAME/PROPULSION CONTROL SYSTEM ARCHITECTURE PROGRAM (IAPSA) **c05**

Daniel L. Palumbo, Gerald C. Cohen (Boeing Advanced Systems Co., Seattle, WA.), and Charles W. Meissner *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 5 p (For primary document see N91-12682 04-08)

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The Integrated Airframe/Propulsion Control System Architecture program (IAPSA) is a two-phase program which was initiated by NASA in the early 80s. The first phase, IAPSA 1, studied different architectural approaches to the problem of integrating engine control systems with airframe control systems in an advanced tactical fighter. One of the conclusions of IAPSA 1 was that the technology to construct a suitable system was available, yet the ability to create these complex computer architectures has outpaced the ability to analyze the resulting system's performance. With this in mind, the second phase of IAPSA approached the same problem with the added constraint that the system be designed for validation. The intent of the design for validation requirement is that validation requirements should be shown to be achievable early in the design process. IAPSA 2 has demonstrated that despite diligent efforts, integrated systems can retain characteristics which are difficult to model and, therefore, difficult to validate. Author

N91-12690# Royal Signals and Radar Establishment, Malvern (England).

DEPENDABLE SYSTEMS USING VIPER

J. Kershaw *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 7 p (For primary document see N91-12682 04-08)

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Computer systems are being used increasingly in applications where a malfunction could cause loss of life or massive environmental damage. Redundancy is used to guard against random hardware failure in such systems, but redundancy alone does not protect against design faults which might affect every

channel at the same time: the classic Common-Cause Failure (CCF). The risk of CCF is all-pervasive. Latent faults can be inserted, over a period, into all the channels of a previously correct system. All these types of event have caused real system breakdowns. The most common defense against design error is diversity, the use of two or more different and separately designed channels which will be assumed to fail independently. This is expensive, and it still does not protect against errors in the original specification. True diverse implementation of software is surprisingly difficult: even when the specification of a program was cleanly separated from its implementation, design decisions usually leak from the specification into some or all of the implementations. At some point, all redundant systems need to decide which channel is faulty. This decision is critical to the operation of the whole system. A simple voter, which merely compares a few logical signals or takes a mean of 3 or 4 analog values, can be made extremely reliable. Digital versions of such a voter are less satisfactory than analog - deciding whether or not several values are within a reasonable tolerance of one another is much easier in the analog world. A really simple digital voter cannot tolerate diverse inputs. The more diverse the channels of a system are, the more complex the decision maker is likely to be. Obviously it must be substantially more reliable than any single channel, or it would compromise the integrity of the system as a whole. Ideally the voter should be distributed among the redundant channels of the system, to minimize the number of critical points at which a single failure would be disabling and to take advantage of diversity in the decision making as well as in the information processing. This leads to Byzantine voting protocols and massive overheads, and still leaves some risk of CCF through errors in the specification. Beyond a certain point, complexity may be self-defeating. Author

N91-12691# General Electric Co., Binghamton, NY. Dept. of Aircraft Control Systems.

FAULT-TOLERANT, FLIGHT-CRITICAL CONTROL SYSTEMS

Tom Sadeghi and Gerry Mayville *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 12 p (For primary document see N91-12682 04-08)

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Two leading Fault-Tolerant, Flight-Critical Systems (FTFCSs) currently being developed are described and compared. These technologies, driven by the aircraft performance, reliability, and maintainability requirements, are: the Self-Repairing Flight Control System (SRFCS) and the Vehicle Management System (VMS). SRFCS has two technology thrusts: Control Reconfiguration Strategy (CRS) and Onboard Expert System (OES). VMS is focused on: Vehicle Management Computer (VMC) development and Integrated Diagnostics System (IDS). SRFCS has the potential to reduce brute force hardware redundancy, where the VMS is driven by increased functional complexity demands for increased hardware redundancy. A cursory examination of these technologies suggests that SRFCS can be considered as a complement to VMS development. Contrary to this view, the attributes of each of these technologies are examined and the needs for future development identified. The remaining challenge to be overcome by systems designers is finding the best balanced solution for the future FTFCS, utilizing a proper blend of SRFCS and VMS technologies.

Author

N91-12692# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Aircraft Div.

METHODS TO PRESERVE THE INTEGRITY OF A COMBAT AIRCRAFT FLIGHT CONTROL SYSTEM THROUGH MAJOR UPGRADE PROGRAMMES

M. Roessler and W. Schmidt *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 9 p (For primary document see N91-12682 04-08)

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During the years of in-service operation, the Autopilot and Flight Director System/Terrain Following (AFDS/TF) subsystem of the PANAVIA TORNADO has gained a high level of confidence. Methods were developed, to keep control of the integrity of the flight critical system through plenty of modifications. As part of major upgrade programs of the weapon system TORNADO, several improvements will be introduced to the automatic flight control system. How the new elements can be integrated into the existing system architecture without jeopardizing the integrity and availability of the system and how the enhanced flight control system will be validated and put into operation are explained. Author

N91-12693# Royal Aircraft Establishment, Farnborough (England).

RESEARCH INTO A MISSION MANAGEMENT AID **c54**

J. R. Catford and I. D. Gray (Ferranti Ltd., Chadderton, England) *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 10 p (For primary document see N91-12682 04-08)

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Pilot workload in fighter aircraft is ever increasing, driven by the need to fly low and the complexity of the systems and weapons in modern aircraft. The density and growing sophistication of Warsaw Pact anti-aircraft weapon systems greatly exacerbate the problem. The current European trend towards single seat fighter aircraft, on grounds of system and manpower costs, increases the workload problem still further. The research project, is directed to put the crew back in charge by introducing new levels of weapon systems automation. The Mission Management Aid (MMA) is scheduled for clearance into service in the first decade of the next century and although it is confidently expected that the airborne computing power to perform the task will be available in that timescale, the complementary disciplines to design, test, and validate such a system needs to be developed. The current research program is concentrated on the timely development of these disciplines. The basic functional approach to the MMA was outlined some four years ago. Research into the MMA is being undertaken jointly by the four industrial organizations and the Royal Aerospace Establishment (RAE). The current program which was running for two years, involves seconded staff from the industrial organizations and the RAE, Farnborough where the team is located. It is very evident that current fighter aircraft systems are composed of a number of well tested evaluated and validated sub-systems and yet the integrated system tends to exhibit serious operational problems and a long time delay before modifications to clear these problems can be introduced. It is hence essential that the more complex systems of the next century exhibit characteristics that allow for rapid modification to meet changing operational needs and yet maintain essential operational integrity through these changes. Author

N91-12694# Honeywell, Inc., Minneapolis, MN. Systems and Research Center.

INTEGRATED DIAGNOSTICS FOR FAULT-TOLERANT SYSTEMS

Harry A. Funk and Mark M. Jeppson *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 9 p (For primary document see N91-12682 04-08)

(Contract F33615-85-C-3613)

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An integrated approach to the maintainability of high-reliability fault-tolerant flight control systems is presented. Modern aircraft provide designers of maintenance systems a tremendous amount of data on the health of subsystem elements. Examples include initiated built-in-test, continuous built-in-test, redundancy management status, reconfiguration status, and time-stress measurement data. Advances in both on-aircraft and off-aircraft diagnostic hardware and software provide the designer with a wide range of partitioning options to most effectively use these data. An integrated maintenance approach is discussed using both a

portable maintenance aid at the flight line and on-aircraft in-flight diagnostic resources. An implementation strategy for each of these systems is presented along with a technique that ensures designed-in commonality between the on-aircraft and off-aircraft systems. The proper use of these systems in addressing particular maintenance problems (re-test okays and cannot-duplicates) is discussed. Author

N91-12695*# Draper (Charles Stark) Lab., Inc., Cambridge, MA. Fault-Tolerant Systems Div.

A BYZANTINE RESILIENT PROCESSOR WITH AN ENCODED FAULT-TOLERANT SHARED MEMORY **c60**

Bryan Butler and Richard Harper *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 12 p (For primary document see N91-12682 04-08)

(Contract NAS1-18565)

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The memory requirements for ultra-reliable computers are expected to increase due to future increases in mission functionality and operating-system requirements. This increase will have a negative effect on the reliability and cost of the system. Increased memory size will also reduce the ability to reintegrate a channel after a transient fault, since the time required to reintegrate a channel in a conventional fault-tolerant processor is dominated by memory realignment time. A Byzantine Resilient Fault-Tolerant Processor with Fault-Tolerant Shared Memory (FTP/FTSM) is presented as a solution to these problems. The FTSM uses an encoded memory system, which reduces the memory requirement by one-half compared to a conventional quad-FTP design. This increases the reliability and decreases the cost of the system. The realignment problem is also addressed by the FTSM. Because any single error is corrected upon a read from the FTSM, a faulty channel's corrupted memory does not need realignment before reintegration of the faulty channel. A combination of correct-on-access and background scrubbing is proposed to prevent the accumulation of transient errors in the memory. With a hardware-implemented scrubber, the scrubbing cycle time, and therefore the memory fault latency, can be upper-bounded at a small value. This technique increases the reliability of the memory system and facilitates validation of its reliability model. Author

N91-12696*# Draper (Charles Stark) Lab., Inc., Cambridge, MA. Fault-Tolerant Systems Div.

A HIGHLY RELIABLE, AUTONOMOUS DATA COMMUNICATION SUBSYSTEM FOR AN ADVANCED INFORMATION PROCESSING SYSTEM **c32**

Gail Nagle, Thomas Masotto, and Linda Alger *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 11 p (For primary document see N91-12682 04-08)

(Contracts NAS1-17666; NAS1-18565)

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The need to meet the stringent performance and reliability requirements of advanced avionics systems has frequently led to implementations which are tailored to a specific application and are therefore difficult to modify or extend. Furthermore, many integrated flight critical systems are input/output intensive. By using a design methodology which customizes the input/output mechanism for each new application, the cost of implementing new systems becomes prohibitively expensive. One solution to this dilemma is to design computer systems and input/output subsystems which are general purpose, but which can be easily configured to support the needs of a specific application. The Advanced Information Processing System (AIPS), currently under development has these characteristics. The design and implementation of the prototype I/O communication system for AIPS is described. AIPS addresses reliability issues related to data communications by the use of reconfigurable I/O networks. When a fault or damage event occurs, communication is restored to functioning parts of the network and the failed or damage components are isolated. Performance issues are addressed by using a parallelized computer architecture which decouples Input/Output (I/O) redundancy management and I/O processing from the computational stream of an application. The autonomous nature of the system derives from the highly automated and independent manner in which I/O transactions are conducted for the application as well as from the fact that the hardware redundancy management is entirely transparent to the application. Author

N91-12697# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes at de Recherches en Informatique.

FORMALIZING DEVELOPMENTS: FROM THEORY TO PRACTICE **c61**

Karim Bechane and Michel Lemoine *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 9 p (For primary document see N91-12682 04-08)

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The need to support the whole process of system development with available and really efficient environments is a major challenge of the software technology. The old paradigms in use is briefly examined. Then a new one is introduced which is well supported by an environment under consideration. In this environment the use of the DEVA language is emphasized which aims at: expressing formal developments; expressing and using development methods; and finally, re-using formal developments for the derivation of new developments and consequently new programs. A realistic example based on the JSP method is introduced, then formalized and expressed in terms of DEVA. The correctness of the run guarantees that the resulting programs satisfies their initial specifications. Author

N91-12698# Crouzet Aerospace and Systems, Valence (France).

BREAKDOWN METHODOLOGY FOR FLIGHT CRITICAL APPLICATIONS INTO ELEMENTARY COMPONENTS **c06**

Bernard Chavana and Francois deSainteMaresville *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 9 p In FRENCH (For primary document see N91-12682 04-08)

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The objective is to explain the steps in specification/conception used in the case of critical product development for aircraft safety. The explanation does not approach from the design aspect, but in the specification sense from the middle of the design (coding, testing....). At each stage, it is shown how a simple step is discovered for assuming project limits. Transl. by E.R.

N91-12699# Royal Signals and Radar Establishment, Malvern (England).

FAULT TOLERANCE VIA FAULT AVOIDANCE **c61**

B. D. Bramson *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 10 p (For primary document see N91-12682 04-08)

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A safety-critical system is proposed whose architecture is based upon software components that have diverse specifications and diverse implementations. It is claimed that a proof of correctness of one of the components implies a proof of safety of the system. The claim is illustrated using the MALPAS intermediate language as a design language and compliance analysis as a verification technique. Author

N91-12700# Grumman Aerospace Corp., Bethpage, NY. Aircraft Systems Div.

PILOTED SIMULATION VERIFICATION OF A CONTROL RECONFIGURATION STRATEGY FOR A FIGHTER AIRCRAFT UNDER IMPAIRMENTS

Richard Mercadante *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 24 p (For primary document see N91-12682 04-08)

(Contract F33615-84-C-3607)

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Piloted simulation performed at the USAF large amplitude multi-mode aerospace research simulator (LAMARS) verified the capability of a reconfiguration strategy to improve aircraft controllability. USAF Tactical Air Command pilots and test pilots from a number of organizations evaluated the characteristics of a next-generation fighter aircraft subjected to control surface damage and/or actuation failures. Tests were performed both with and without the aid of the reconfiguration strategy. For the aircraft configuration simulated, pilot opinions, ratings, and target tracking scores demonstrated the capability of the system to improve aircraft response for a large variety of control surface impairments throughout the subsonic flight envelope. Results ranged from slight to dramatic improvement and departure prevention. Author

N91-12701*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

FLIGHT TEST RESULTS OF FAILURE DETECTION AND ISOLATION ALGORITHMS FOR A REDUNDANT STRAPDOWN INERTIAL MEASUREMENT UNIT **c04**

F. R. Morrell, P. R. Motyka, and M. L. Bailey (PRC Kentron, Inc., Hampton, VA.) *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 13 p (For primary document see N91-12682 04-08)

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Flight test results for two sensor fault-tolerant algorithms developed for a redundant strapdown inertial measurement unit are presented. The inertial measurement unit (IMU) consists of four two-degrees-of-freedom gyros and accelerometers mounted on the faces of a semi-octahedron. Fault tolerance is provided by edge vector test and generalized likelihood test algorithms, each of which can provide dual fail-operational capability for the IMU. To detect the wide range of failure magnitudes in inertial sensors, which provide flight crucial information for flight control and navigation, failure detection and isolation are developed in terms of a multi level structure. Threshold compensation techniques, developed to enhance the sensitivity of the failure detection process to navigation level failures, are presented. Four flight tests were conducted in a commercial transport-type environment to compare and determine the performance of the failure detection and isolation methods. Dual flight processors enabled concurrent tests for the algorithms. Failure signals such as hard-over, null, or bias shift, were added to the sensor outputs as simple or multiple failures during the flights. Both algorithms provided timely detection and isolation of flight control level failures. The generalized likelihood test algorithm provided more timely detection of low-level sensor failures, but it produced one false isolation. Both algorithms demonstrated the capability to provide dual fail-operational performance for the skewed array of inertial sensors. Author

N91-12702*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.

FLIGHT DEMONSTRATION OF A SELF REPAIRING FLIGHT CONTROL SYSTEM IN A NASA F-15 FIGHTER AIRCRAFT

James M. Urnes, James Stewart, and Robert Eslinger (Wright Research Development Center, Wright-Patterson AFB, OH.) *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 17 p (For primary document see N91-12682 04-08)

Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive CSCL 01C

Battle damage causing loss of control capability can compromise mission objectives and even result in aircraft loss. The Self Repairing Flight Control System (SRFCS) flight development program directly addresses this issue with a flight control system design that measures the damage and immediately refines the control system commands to preserve mission potential. The system diagnostics process detects in flight the type of faults that are difficult to isolate post flight, and thus cause excessive ground maintenance time and cost. The control systems of fighter aircraft have the control power and surface displacement to maneuver the aircraft in a very large flight envelope with a wide variation in airspeed and g maneuvering conditions, with surplus force capacity available from each control surface. Digital flight control processors are designed to include built-in status of the control system components, as well as sensor information on aircraft control maneuver commands and response. In the event of failure or loss of a control surface, the SRFCS utilizes this capability to reconfigure control commands to the remaining control surfaces, thus preserving maneuvering response. Correct post-flight repair is the key to low maintainability support costs and high aircraft mission readiness. The SRFCS utilizes the large data base available with digital flight control systems to diagnose faults. Built-in-test data and sensor data are used as inputs to an Onboard Expert System process to accurately identify failed components for post-flight maintenance action. This diagnostic technique has the advantage of functioning during flight, and so is especially useful in identifying intermittent faults that are present only during maneuver g loads or high hydraulic flow requirements. A flight system was developed to test the reconfiguration and onboard maintenance diagnostics concepts on a NASA F-15 fighter aircraft. Author

N91-12703# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

FLIGHT TESTING OF A REDUNDANT FBW/FBL HELICOPTER CONTROL SYSTEM

H. Becker, K. Bender, K. D. Holle, and G. Mansfeld *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 13 p (For primary document see N91-12682 04-08)

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The DLR has designed and developed an experimental fault-tolerant four-axes flight control computer system for helicopters named DISCUS. The acronym stands for Digital Self-healing Control for Upgraded Safety. The main objective for the design of this computer system was to get a tool for various research tasks related to fault-tolerance, control law design and flight testing of new technologies. The design features of the DISCUS flight control computer system, the hardware realization, the software functions implemented so far and results of flight tests, all this performed in close cooperation with German industry are described. Although the hardware and the executive software of the flight control computer system are designed for four-axes applications, in the reported phase the DISCUS system is first of all flight tested in the yaw-axis control mode only. Author

N91-12704# Crouzet Aerospace and Systems, Valence (France).

A HIGH INTEGRITY FLIGHT DATA SYSTEM **c04**

J. L. Roch and J. Contet *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 10 p In FRENCH (For primary document see N91-12682 04-08)

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Solutions are described for the design of a modern flight data system to be used for piloting and navigation of helicopters. The critical flight system is used in the aircraft safety cable and responds

to a certain number of specific limits. First, the problems which cause the limits are examined; next, the methods and technologies are described for reaching satisfaction. Transl. by E.R.

N91-12705*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HYPERSONIC VEHICLE SIMULATION MODEL: WINGED-CONE CONFIGURATION
John D. Shaughnessy, S. Zane Pinckney, John D. McMinn, Christopher I. Cruz, and Marie-Louise Kelley Nov. 1990 142 p
(NASA-TM-102610; NAS 1.15:102610) Avail: NTIS HC/MF A07 CSCL 01C

Aerodynamic, propulsion, and mass models for a generic, horizontal-takeoff, single-stage-to-orbit (SSTO) configuration are presented which are suitable for use in point mass as well as batch and real-time six degree-of-freedom simulations. The simulations can be used to investigate ascent performance issues and to allow research, refinement, and evaluation of integrated guidance/flight/propulsion/thermal control systems, design concepts, and methodologies for SSTO missions. Aerodynamic force and moment coefficients are given as functions of angle of attack, Mach number, and control surface deflections. The model data were estimated by using a subsonic/supersonic panel code and a hypersonic local surface inclination code. Thrust coefficient and engine specific impulse were estimated using a two-dimensional forebody, inlet, nozzle code and a one-dimensional combustor code and are given as functions of Mach number, dynamic pressure, and fuel equivalence ratio. Rigid-body mass moments of inertia and center of gravity location are functions of vehicle weight which is in turn a function of fuel flow. Author

N91-12706# Naval Air Development Center, Warminster, PA. Dept. of Air Vehicle and Crew Systems Technology.
OPTIMAL CONTROL AND MODEL REDUCTION USING A FINITE-INTERVAL H UPSILON CRITERION Final Report, Mar. 1989 - Mar. 1990
M. Bala Subrahmanyam Apr. 1990 49 p Sponsored by Office of Naval Technology, Arlington, VA
(AD-A226490; NADC-90043-60) Avail: NTIS HC/MF A03 CSCL 01/4

A finite-interval H sub infinity control problem is posed and solved making use of nonlinear programming algorithms. An important problem in flight control and flying qualities is the approximation of a complex high order system by a low order model. Making use of a certain correlation index, the model reduction problem is solved by selecting the reduced order model matrices which give the best correlation index. GRA

N91-12570*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN EVALUATION OF AUTOMATIC CONTROL SYSTEM CONCEPTS FOR GENERAL AVIATION AIRPLANES
E. C. Stewart *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 236-259 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17 CSCL 01C

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N91-12707 ESDU International Ltd., London (England).
FREQUENCIES OF RESONANCE IN WIND TUNNELS WITH VENTILATED WALLS AND PLENUM CHAMBER Abstract Only
Apr. 1990 16 p
(ESDU-90005; ISBN-0-85679-730-8; ISSN-0141-397X) Avail: ESDU

ESDU 90005 derives semi-empirical equations for the resonance frequencies that occur at subsonic speeds in wind-tunnels with walls having slots or circular perforations. Results from the equations for the first resonance frequency (which can limit the usefulness of the tunnel for dynamic testing) are presented graphically for plenum chamber depth-to-height ratios of between 2 and 4. Comparisons between predictions by the method and both test data and finite element calculations suggest the accuracy maybe within 10 percent at Mach numbers below 0.8 but may fall to 20 percent at higher subsonic Mach numbers. Two examples illustrating the use of the Item are included. A FORTRAN program of the prediction method is available on magnetic media as ESDUpac 9005. ESDU

N91-12708# Stuttgart Univ. (Germany, F.R.). Inst. fuer Luftfahrtantriebe.
ENHANCEMENT OF THE STUTTGART ALTITUDE TEST FACILITY
W. Braig 1990 16 p
(ETN-90-97860) Avail: NTIS HC/MF A03

The rather small capacity of the Stuttgart altitude test facility originally established 25 years ago was increased according to the test programs expected for the future. Two additional compressors with appropriate piping, cooling and control systems applicable for both intake air compression and exhaust gas evacuation were installed. A new exhaust gas cooling system was established, now allowing reheat testing up to stoichiometric combustion. Other features include an additional test cell with a hydrostatic thrust balance, an inertia air cleaner and an increased data recording and display system for plant control. The enhanced plant allows testing of engines and components with massflows up to 140 kg/s and with flight Mach numbers up to 2.2. ESA

N91-12709# Anacapa Sciences, Inc., Fort Rucker, AL.
TRANSFER-OF-TRAINING STUDY OF EMERGENCY TOUCHDOWN MANEUVERS IN THE AH-1 FLIGHT AND WEAPONS SIMULATOR Interim Report, Feb. 1987 - Jun. 1988
George L. Kaempf and N. Joan Blackwell (Army Research Inst. Aviation Research and Development Activity, Fort Rucker, AL.) Jun. 1990 76 p
(Contract MDA903-87-C-0523; DA Proj. 2Q2-63007-A-795)
(AD-A226360; ASI690-311-88; ARI-RR-1561) Avail: NTIS HC/MF A05 CSCL 05/6

Researches conducted a transfer of training study to investigate the effectiveness of the AH-1 Flight and Weapons Simulator (FWS) as a training device for the reacquisition of skills on five emergency touchdown maneuvers (ETMs). Twenty aviators assigned to operational aviation units served as subjects. All aviators received initial check rides in the aircraft and the FWS and were assigned to one of two groups on the basis of their checkride scores. The control group received training to proficiency in the aircraft on each of the five maneuvers and a second checkride in the FWS. The experimental group received training to proficiency in the FWS on each of the five maneuvers followed by similar training in the aircraft. Analysis of the initial checkride scores indicated that the aviator's skills were deficient on the ETMs prior to the study. They required extensive training to reach proficiency in the FWS but relatively little training to regain proficiency in the aircraft. Prior training in the FWS reduced the number of practice trials and the amount of flight training time required to reach proficiency in the aircraft. However, training in the existing FWS alone is insufficient for reacquisition of ETM skills to a standard of aircraft proficiency. In view of the prohibition on practice of ETMs in the aircraft, it is recommended that the Army initiate a product improvement program for the FWS. GRA

N91-12710# Naval Postgraduate School, Monterey, CA.
MOVING PLATFORM SIMULATOR 3: AN ENHANCED HIGH-PERFORMANCE REAL-TIME GRAPHICS SIMULATOR WITH MULTIPLE RESOLUTION DISPLAY AND LIGHTING M.S. Thesis
Curtis P. Cheeseman Jun. 1990 56 p
(AD-A226393) Avail: NTIS HC/MF A04 CSCL 12/5

This thesis is a continuation of previous work conducted in the development of low cost real-time moving platform simulators using three-dimensional digital terrain elevation data and a high-performance Silicon Graphics, Inc., 4D/120GTX graphics workstation. Most notably this effort combines work conducted on previous models to display high-resolution terrain in multiple interval resolutions using either polygon or mesh drawing algorithms. In addition to the simulator's capability to display the special high-resolution terrain data provided by the United States Army Test and Experimentation Data (DTED). Further work was performed enhancing user interfaces and visual displays. This paper describes the simulator, Moving Platform Simulator III (MPS III), listing its enhancements and features. GRA

N91-12711# Sandia National Labs., Albuquerque, NM.
STANDARDS LABORATORY ENVIRONMENTS
David W. Braudaway Sep. 1990 9 p
(Contract DE-AC04-76DP-00789)
(DE91-000459; SAND-90-1962) Avail: NTIS HC/MF A02

Standards Laboratory environments need to be carefully selected to meet the specific mission of each laboratory. The mission of the laboratory depends on the specific work supported, the measurement disciplines required and the level of uncertainty required in the measurements. This document reproduces the contents of the Sandia National Laboratories Primary Standards Laboratory Memorandum Number 3B (PSLM-3B) which was issued on May 16, 1988, under the auspices of the Department of Energy, Albuquerque Operations Office, to guide the laboratories of the Nuclear Weapons Complex in selecting suitable environments. Because of both general interest and specific interest in Standards Laboratory environments this document is being issued in a more available form. The purpose of this document is to provide guidance in selection of laboratory environments suitable for standards maintenance and calibration operations. It is not intended to mandate a specific environment for a specific calibration but to direct selection of the environment and to offer suggestions on how to extend precision in an existing and/or achievable (practical) environment. Although this documents pertains specifically to standards laboratories, it can be applied to any laboratory requiring environmental control. DOE

N91-12712*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A USER'S GUIDE TO THE LANGLEY 16-FOOT TRANSONIC TUNNEL COMPLEX. REVISION 1
Sep. 1990 240 p Supersedes NASA-TM-83186
(NASA-TM-102750; NAS 1.15:102750) Avail: NTIS HC/MF A11 CSCL 14B

The operational characteristics and equipment associated with the Langley 16-foot transonic tunnel complex which is located in buildings 1146 and 1234 at the Langley Research Center are described in detail. This complex consists of the 16-foot transonic wind tunnel, the static test facility, and the 16- by 24-inch water tunnel research facilities. The 16-foot transonic tunnel is a single-return atmospheric wind tunnel with a 15.5 foot diameter test section and a Mach number capability from 0.20 to 1.30. The emphasis for research conducted in this research complex is on the integration of the propulsion system into advanced aircraft concepts. In the past, the primary focus has been on the integration of nozzles and empennage into the afterbody of fighter aircraft. During the last several years this experimental research has been expanded to include developing the fundamental data base necessary to verify new theoretical concepts, inlet integration into fighter aircraft, nozzle integration for supersonic and hypersonic transports, nacelle/pylon/wing integration for subsonic transport configurations, and the study of vortical flows (in the 16- by 24-inch water tunnel). The purpose here is to provide a comprehensive description of the operational characteristics of the research facilities of the 16-foot transonic tunnel complex and their associated systems and equipments. Author

N91-13338*# Christian Brothers Coll., Memphis, TN. Dept. of Chemical Engineering.
FINE-TUNING OF PROCESS CONDITIONS TO IMPROVE PRODUCT UNIFORMITY OF POLYSTYRENE PARTICLES USED FOR WIND TUNNEL VELOCIMETRY
Asit K. Ray *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 101-103 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 14B

N91-13340*# Virginia Commonwealth Univ., Richmond. Dept. of Mathematical Sciences.
FACILITATING RESEARCHER USE OF FLIGHT SIMULATORS
C. Ray Russell *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 107-109 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N91-12713# Lawrence Livermore National Lab., CA.
SECURING AMERICA'S ACCESS TO SPACE
Michael Rendine and Lowell Wood 23 May 1990 13 p Presented at the US Space Foundation Space Launch Forum, Colorado Springs, CO, 23-25 May 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-000412; UCRL-JC-103946; CONF-9005277-1) Avail: NTIS HC/MF A03

We review pertinent aspects of the history of the space launch capabilities of the United States and survey its present status and near-term outlook. Steps which must be taken, pitfalls which much be avoided, and a core set of National options for re-acquiring in the near term the capability to access the space environment with large payloads are discussed. We devote considerable attention to the prospect of creating an interim heavy-lift space launch vehicle of at least 100,000 pound payload-orbiting capacity to serve National needs during the next dozen years, suggesting that such a capability can be demonstrated within 5 years for less than $1 B. Such capability will apparently be essential for meeting the first-phase goals of the President's Space Exploration Initiative. Some other high-leverage aspects of securing American access to space are also noted briefly, emphasizing unconventional technological approaches of presently high promise. DOE

N91-12714# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
[ACTIVITIES REPORT OF THE INSTITUTE OF PLANETARY SPACE PHYSICS] Annual Report, 1989 [RAPPORTO DI ATTIVITA 1989. CNR-ISTITUTO DI FISICA DELLO SPAZIO INTERPLANETARIO]
Apr. 1990 32 p In ITALIAN
(IFSI-90-11; ETN-90-97794) Avail: NTIS HC/MF A03

The described activities are grouped into space experiments, laboratory activities, data analysis, theoretical studies, and the all sky camera project for the Antarctic. The space experiments include tethered satellite system experiments, a plasma experiment for the ESA Cluster satellite, a wave measurement experiment on the Interbol Soviet satellite, and an experiment to measure Mars atmosphere on the Mars 94 Soviet satellite. ESA

N91-12727# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
PROJECTS OF THE EUROPEAN SPACE TRAVEL PROGRAM [PROJEKTE DES EUROPAEISCHEN RAUMFAHRTPROGRAMMS]
Dietmar Frenzel *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German

Companies in Space Travel Research 1989 p 33-43 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

N91-12728# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
PROJECTS OF THE EUROPEAN SPACE TRAVEL PROGRAM [PROJEKTE DES EUROPAEISCHEN RAUMFAHRPROGRAMMS]
Gottfried Greger *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 45-62 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N91-12715*# LinCom Corp., Houston, TX.
RESEARCH AND DEVELOPMENT FOR ONBOARD NAVIGATION (ONAV) GROUND BASED EXPERT/TRAINER SYSTEM: FINAL USER'S GUIDE
Daniel C. Bochsler 12 Apr. 1988 58 p Prepared in cooperation with Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187242; NAS 1.26:187242) Avail: NTIS HC/MF A04 CSCL 14B

The purpose is to present procedures for preparation, operation, monitoring, and recovery of the Shuttle Onboard Navigation (ONAV) Entry phase expert system. This user's guide is primarily intended for functional users of the system. It includes procedures for system operation in support of training activities as well as operational tasks. In addition, information is provided which enables maintenance personnel to handle updates, modifications, etc. to the system. Author

N91-12716*# LinCom Corp., Houston, TX.
RESEARCH AND DEVELOPMENT FOR ONBOARD NAVIGATION (ONAV) GROUND BASED EXPERT/TRAINER SYSTEM: PRELIMINARY TEST PLAN
Daniel C. Bochsler 15 Apr. 1988 39 p Prepared in cooperation with Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187243; NAS 1.26:187243) Avail: NTIS HC/MF A03 CSCL 14B

The test plan for the onboard navigation (ONAV) expert system is described. Levels of testing are identified and the contributing role of each level for ensuring reliability is described. Also, the objectives of each type of test are identified and a summary of the test methods and the type of testing environment to be used is included. The ONAV expert system testing effort utilizes a multi-level verification approach. Five levels of testing are performed in essentially a serial manner: (1) individual rules, (2) ordered and unordered functional groups, (3) interface rules, (4) system tests, and (5) user tests. The intent is to catch the full range of both programming errors common to traditional programming and those errors characteristic of expert systems including factbase organization and inference engine interactions. Author

N91-12717*# LinCom Corp., Houston, TX.
RESEARCH AND DEVELOPMENT FOR ONBOARD NAVIGATION (ONAV) GROUND BASED EXPERT/TRAINER SYSTEM: PRELIMINARY ASCENT KNOWLEDGE REQUIREMENTS
Daniel C. Bochsler Aug. 1988 53 p Prepared in cooperation with Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187244; NAS 1.26:187244) Avail: NTIS HC/MF A04 CSCL 14B

The preliminary version of expert knowledge for the Onboard Navigation (ONAV) Ground Based Expert Trainer Ascent system for the space shuttle is presented. Included is some brief background information along with the information describing the knowledge the system will contain. Information is given on rules and heuristics, telemetry status, landing sites, inertial measurement units, and a high speed trajectory determinator (HSTD) state vector. Author

N91-12718*# LinCom Corp., Houston, TX.
RESEARCH AND DEVELOPMENT FOR ONBOARD NAVIGATION (ONAV) GROUND BASED EXPERT/TRAINER SYSTEM: TEST REPORT
Daniel C. Bochsler Aug. 1988 121 p Prepared in cooperation with Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187245; NAS 1.26:187245) Avail: NTIS HC/MF A06 CSCL 14B

The test results for the onboard navigation (ONAV) Ground Based Expert System Trainer System for an aircraft/space shuttle navigation entry phase system are described. A summary of the test methods and analysis results are included. Functional inspection and execution, interface tests, default data sources, function call returns, status light indicators, and user interface command acceptance are covered. Author

N91-12719*# LinCom Corp., Houston, TX.
RESEARCH AND DEVELOPMENT FOR ONBOARD NAVIGATION (ONAV) GROUND BASED EXPERT/TRAINER SYSTEM: PRELIMINARY USER'S GUIDE
Daniel C. Bochsler 8 Jan. 1988 59 p Prepared in cooperation with Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187246; NAS 1.26:187246) Avail: NTIS HC/MF A04 CSCL 14B

The purpose is to present procedures for preparation, operation, monitoring, and recovery of the Shuttle Entry phase expert system that is part of the Onboard Navigation (ONAV) Ground Based Expert System Trainer System for aircraft/space shuttle navigation. This user's guide is primarily intended for functional users of the system. It includes procedures for system operation in support of training activities as well as operational tasks. In addition, information is provided which enables maintenance personnel to handle updates, modifications, etc. to the system. Author

N91-12720*# LinCom Corp., Houston, TX.
RESEARCH AND DEVELOPMENT FOR ONBOARD NAVIGATION (ONAV) GROUND BASED EXPERT/TRAINER SYSTEM: ONAV ENTRY EXPERT SYSTEM CODE
Daniel C. Bochsler 28 Jan. 1988 181 p Prepared in cooperation with Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187248; NAS 1.26:187248) Avail: NTIS HC/MF A09 CSCL 14B

A complete listing is given of the expert system rules for the Entry phase of the Onboard Navigation (ONAV) Ground Based Expert Trainer System for aircraft/space shuttle navigation. These source listings appear in the same format as utilized and required

by the C Language Integrated Production System (CLIPS) expert system shell which is the basis for the ONAV entry system. A schematic overview is given of how the rules are organized. These groups result from a partitioning of the rules according to the overall function which a given set of rules performs. This partitioning was established and maintained according to that established in the knowledge specification document. In addition, four other groups of rules are specified. The four groups (control flow, operator inputs, output management, and data tables) perform functions that affect all the other functional rule groups. As the name implies, control flow ensures that the rule groups are executed in the order required for proper operation; operator input rules control the introduction into the CLIPS fact base of various kinds of data required by the expert system; output management rules control the updating of the ONAV expert system user display screen during execution of the system; and data tables are static information utilized by many different rule sets gathered in one convenient place. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N91-12721*# Michigan Univ., Ann Arbor. Real-Time Computing Lab.

STUDY ON FAULT-TOLERANT PROCESSORS FOR ADVANCED LAUNCH SYSTEM Final Report

Kang G. Shin and Jyh-Charn Liu 27 Nov. 1990 35 p

(Grant NAG1-981)

(NASA-CR-187637; NAS 1.26:187637) Avail: NTIS HC/MF A03 CSCL 22D

Issues related to the reliability of a redundant system with large main memory are addressed. The Fault-Tolerant Processor (FTP) for the Advanced Launch System (ALS) is used as a basis for the presentation. When the system is free of latent faults, the probability of system crash due to multiple channel faults is shown to be insignificant even when voting on the outputs of computing channels is infrequent. Using channel error maskers (CEMs) is shown to improve reliability more effectively than increasing redundancy or the number of channels for applications with long mission times. Even without using a voter, most memory errors can be immediately corrected by those CEMs implemented with conventional coding techniques. In addition to their ability to enhance system reliability, CEMs (with a very low hardware overhead) can be used to dramatically reduce not only the need of memory realignment, but also the time required to realign channel memories in case, albeit rare, such a need arises. Using CEMs, two different schemes were developed to solve the memory realignment problem. In both schemes, most errors are corrected by CEMs, and the remaining errors are masked by a voter. Author

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N91-12722# Office of Technology Assessment, Washington, DC.

ACCESS TO SPACE: THE FUTURE OF US SPACE TRANSPORTATION SYSTEMS

May 1990 95 p

(PB90-253154; OTA-ISC-415) Avail: NTIS HC/MF A05; also available SOD HC $4.75 as 052-003-01177-8 CSCL 22A

The Nation's ability to explore space and use the opportunities it offers depends on having a fleet of versatile and reliable launch vehicles. This report, which summarizes the Office of Technological Assessments (OTA's) assessment of space transportation technologies, examines a wide range of potential improvements in safety, reliability, and performance for the Space Shuttle and our fleet of expendable launch vehicles. Decisions taken now will affect the future of spaceflight in the 21st century, when the Nation will need replacements for current launch systems. The report also explores the potential for advanced systems such as an advanced manned launch system, or a national aerospace plane, which could revolutionize access to space. GRA

N91-12723# Air Force Geophysics Lab., Hanscom AFB, MA. Space Physics Div.

RECOVERY OF IMAGES FROM THE AMOS ELSI DATA FOR STS-33 Scientific Interim Report

David J. Knecht 19 Apr. 1990 40 p

(AF Proj. S321)

(AD-A225653; GL-TR-90-0128; GL-ERP-1063) Avail: NTIS HC/MF A03 CSCL 17/5

During the STS-33 space-shuttle mission in November 1989, ground-based observations of the shuttle were made from the Air Force Maui Optical Station (AMOS) in Hawaii during five orbits that passed near the observatory. The objective of these measurements was the study of interactions between contaminant gases of the shuttle and the residual atmosphere at orbit altitude. The Enhanced Longwave Spectral Imager (ELSI) was one of the instruments used. The ELSI employs two infrared-sensitive array detectors at a telescope focal plane. The recorded digital data from the Medium-Wavelength InfraRed (MWIR) detector used in this instance were found to be unusable under ordinary processing methods because five of the twelve bits in each pixel value were found not to be operating. This report describes the further examination of these data, the discovery of other faults in the instrument, and the subsequent development of software routines and a correction algorithm that succeeded in completely recovering the true images contained in the data. Criteria for the success of this method are examined in the course of describing the design of the algorithm. The method has been transferred to the organization that will process similarly flawed classified data from this instrument. GRA

N91-12724*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SAFETY POLICY AND REQUIREMENTS FOR PAYLOADS USING THE SPACE TRANSPORTATION SYSTEM

Jan. 1989 59 p

(NASA-TM-103437; NSTS-1700-7B; NAS 1.15:103437) Avail: NTIS HC/MF A04 CSCL 22B

The safety policy and requirements are established applicable to the Space Transportation System (STS) payloads and their ground support equipment (GSE). The requirements are intended to protect flight and ground personnel, the STS, other payloads, GSE, the general public, public-private property, and the environment from payload-related hazards. The technical and system safety requirements applicable to STS payloads (including payload-provided ground and flight supports systems) during ground and flight operations are contained. Author

N91-12725# Deutscher Industrie- und Handelstag, Bonn (Germany, F.R.).

SPACE TRAVEL ECONOMICS: PROSPECTS FOR A GREATER PARTICIPATION OF GERMAN COMPANIES IN SPACE TRAVEL RESEARCH [RAUMFAHRT FUER DIE WIRTSCHAFT: DEUTSCHE UNTERNEHMEN IN DIE RAUMFAHRT STAERKER EINBINDEN]

1989 229 p In ENGLISH and GERMAN DIHT-Raumfahrt-Symposium held in Bonn, Fed. Republic of Germany, 18 Apr. 1989

(ETN-90-97911) Avail: NTIS HC/MF A11

The future service possibilities of space travel, in particular small and medium size operations are examined. The last twenty years of European space travel research, the projects of the European space program, the industrial policy of the European Space Agency, the national claims in connection with space research projects, the industrial and scientific services of space travel technological fields, and the opportunities for German small and medium size companies are successively dealt with. For individual titles, see N91-12726 through N91-12736.

N91-12726# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
TWENTY-FIVE YEARS OF EUROPEAN SPACE TRAVEL [25 JAHRE EUROPAEISHE RAUMFAHRT]
Heinz Riesenhuber *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 3-19 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The history of the European Space Agency from its creation in 1970, as a merger with the other two European space organizations founded in 1964, is described. It is shown that science and fundamental research represent a great part of the space travel program. The international cooperation with Japan, the U.S. and the USSR is mentioned. The services and the applications developed mainly through weather and telecommunication satellites are presented. Earth observation, manned space travel, launcher construction, and free weight experiments are emphasized. The costs of European space travel are evaluated and compared to those of the U.S. and the USSR. The German part of private companies in space travel, and the search for markets are discussed. The role of states in space research is mentioned.
ESA

N91-12727# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
PROJECTS OF THE EUROPEAN SPACE TRAVEL PROGRAM [PROJEKTE DES EUROPAEISCHEN RAUMFAHRTPROGRAMMS] **c12**
Dietmar Frenzel *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 33-43 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The balance sheet and the long term program decision are outlined. The application program, including Columbus, Ariane 5 and Hermes, the Hipparcos and ROSAT satellites, the microgravitation, the Spacelab, the Earth observation from satellites are presented. The costs and financing up to year 2000 are discussed.
ESA

N91-12728# Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
PROJECTS OF THE EUROPEAN SPACE TRAVEL PROGRAM [PROJEKTE DES EUROPAEISCHEN RAUMFAHRPROGRAMMS] **c12**
Gottfried Greger *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 45-62 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The Ariane 5, Columbus and Hermes projects are reviewed in detail and the new scientific field of research using zero gravity are outlined. In this connection, the EURECA platform is presented. Annexed tables show the cost distribution among ESA European partners, and the industrial organization for Ariane 5, Hermes and Columbus.
ESA

N91-12729# European Space Agency, Paris (France).
ESA INDUSTRIAL POLICY DATE AND TENDER PROCESS [INDUSTRIEPOLITISCHE VORGABEN UND AUSSCHREIBUNGSVERFAHREN DER ESA] **c81**
Winfried Thoma *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 65-80 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The working strategy of ESA is described: once the projects are established, the interest of users such as the administration in charge of mail, meteorology, etc. is drawn. The cooperation with industry is of particular importance. The industrial competition problems are outlined, as well as the technology transfer necessity. Practical means of registration are mentioned. Annexed tables give the 1989 budget, and the member state contribution to 1989 specified program.
ESA

N91-12730# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
NATIONAL GERMAN HANDLING OF SPACE TRAVEL PROJECTS AND ACCESS POSSIBILITIES TO SPACE TRAVEL TASKS [NATIONALE FOERDERUNG VON RAUMFAHRTVORHABEN UND MOEGLICHKEITEN DES ZUGANGS ZU RAUMFAHRTAUFGABEN] **c81**
Norbert Kiehne *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 85-94 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The aims of the German space travel project are outlined, in particular innovation through space travel technique applications and increase in competitive ability for the German industry. The tender process is described. Advice is given to the small and medium size industries on how to gain access to the space travel market.
ESA

N91-12731# INTOSPACE G.m.b.H., Hanover (Germany, F.R.).
INDUSTRIAL AND SCIENTIFIC APPLICATION OF SPACE TRAVEL [INDUSTRIELLE UND WISSENSCHAFTLICHE NUTZUNG DER RAUMFART] **c81**
Juergen vonderLippe *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 97-101 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The importance of weightlessness as an industrial application is outlined. A medium size company, whose task is to foster weightlessness application in the industry is presented. Using as an example the COSIMA mission, the company marketing strategy is explained.
ESA

N91-12732# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
INDUSTRIAL AND SCIENTIFIC APPLICATION OF SPACE TRAVEL [INDUSTRIELLE UND WISSENSCHAFTLICHE NUTZUNG DER RAUMFAHRT] **c81**
Hans M. Kappler *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 103-121 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The role of industry in space travel operation is outlined, taking as examples Ariane 4, TEXUS and EURECA programs. The ARIANESPACE company market is presented. The share of the European launcher Ariane in the world market is examined in relation to various hypotheses.
ESA

N91-12733# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.).
TECHNOLOGICAL FIELDS AND PROFILES IN SPACE TRAVEL: PROSPECTS FOR SMALL AND MIDDLE SIZE COMPANIES [TECHNOLOGIEFELDER UND -PROFILE IN DER RAUMFAHRT: CHANCEN FUER KLEINE UND MITTLERE UNTERNEHMEN] **c81**
Ernst Hoegenauer *In* Deutscher Industire- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German

Companies in Space Travel Research 1989 p 127-139 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The characteristics of the various space travel systems, the main tasks, and the technological trends are outlined. The space travel project requirements, such as a high quality product, a know how for the specification, the development and the operation of the required test and simulation facilities, are mentioned. The tasks which could be offered to small and middle size companies are given. ESA

N91-12734# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
TECHNOLOGICAL FIELDS AND PROFILE IN SPACE TRAVEL: PROSPECTS FOR SMALL AND MEDIUM SIZE COMPANIES [TECHNOLOGIEFELDER UND -PROFILE IN DER RAUMFAHRT: CHANCEN FUER KLEINE UND MITTLERE UNTERNEHMEN]
Joachim Majus *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 149-159 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The specific character of space travel technology is outlined, in particular the transport high cost and its technical limits, as well as the space medium conditions, i.e., vacuum, radiation, temperature differences which require high material properties for the space vehicle. The complexity of the execution of space travel systems shows clearly that only big companies can carry them out, small and medium size companies being, in general, subcontractors for these companies. They can also be engaged in scientific instrument production. As space travel does not require mass production, the small and middle size companies cooperation in development process requires a high innovation ability and flexibility for required changes. ESA

N91-12735# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
EXPERIENCE-BASED REPORT OF A SYSTEM LEADER COMPANY [ERFAHRUNGSBERICHT EINER SYSTEMFUEHRUNGSFIRMA] **c81**
Manfred Hollstein *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 161-174 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

The cooperation between leader companies and small and medium size ones is defined. An increase in such a cooperation during recent years is outlined. The results of an enquiry showed that the questioned small companies had been working from three to twenty five years for the leader company and that the cooperation in space travel tasks was considered positive by a great majority of them. Space travel leader companies need the small and medium size companies as subcontractors. Some small and medium sized companies created a specific market in space flight activities. These companies should be helped, in the future, to take part in the space travel market. ESA

N91-12736# Von Hoerner und Sulger Electronic G.m.b.H., Schwetzingen (Germany, F.R.).
EXPERIENCE-BASED REPORT OF A SYSTEM LEADER COMPANY [ERFAHRUNGSBERICHT EINES RAUMFAHRTERFAHRENEN KLEINEN UNTERNEHMENS] **c81**
Hanna vonHoerner *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 175-187 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

A company whose activity devoted to space travel amounts to 50 percent is introduced. A selection of recent space travel projects is presented. The necessity of smaller national projects is outlined, so that small and medium size companies could take part in them. A simplification of the contract procedure is required. The particular capacity of small and medium size companies for pioneer work, so frequent in space travel research, is outlined. It is recommended that space travel project participation not be restricted to those small and medium size companies which are dependent on leader companies, on account of their capital or their organization. ESA

N91-13323*# Virginia Commonwealth Univ., Richmond. Dept. of Chemistry.
QUANTITATIVE ANALYSIS OF ICE FILMS BY NEAR-INFRARED SPECTROSCOPY
Joseph T. Keiser *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 69-70 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 22B

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N91-12737*# Lockheed Missiles and Space Co., Huntsville, AL. Astronautics Group.
GEOSTATIONARY PLATFORM STUDY: ADVANCED ESGP/EVOLUTIONARY SSF ACCOMMODATION STUDY Final Report
Aug. 1990 231 p
(Contract NAS8-36103)
(NASA-CR-184037; NAS 1.26:184037) Avail: NTIS HC/MF A11 CSCL 22B

The implications on the evolutionary space station of accommodating geosynchronous Earth Orbit (GEO) facilities are assessed. These facilities include unmanned satellites and platforms, manned elements, and transportation and servicing vehicles/elements. The latest existing definitions of typical unmanned GEO facilities and transportation and servicing vehicles/elements are utilized. The physical design, functional design, and operations implications at the space station are determined. Various concepts of the space station from past studies are utilized ranging from the IOC Multifunction Space Station to a branched transportation node space station and the implications of accommodating the GEO infrastructure at each type are assessed. Where possible, parametric data is provided to show the implications of variations in sizes and quantities of elements, launch rates, crew sizes, etc. The use of advanced automation, robotics equipment, and an efficient mix of manned/automated support for accomplishing necessary activities at the space station are identified and assessed. The products of this study are configuration sketches, resource requirements, trade studies, and parametric data. Author

N91-12738*# Lockheed Missiles and Space Co., Huntsville, AL. Astronautics Div.

GEOSTATIONARY PLATFORM STUDY: ADVANCED ESGP/EVOLUTIONARY SSF ACCOMMODATION STUDY Final Report

Aug. 1990 232 p

(Contract NAS8-36103)

(NASA-CR-184036; NAS 1.26:184036; LMSC-F393987) Avail: NTIS HC/MF A11 CSCL 22B

The implications on the evolutionary space station of accommodating geosynchronous Earth Orbit (GEO) facilities including unmanned satellites and platforms, manned elements, and transportation and servicing vehicles/elements. The latest existing definitions of typical unmanned GEO facilities and transportation and servicing vehicles/elements are utilized. The physical design, functional design, and operations implications at the space station are determined. Various concepts of the space station from past studies are utilized ranging from the IOC Multifunction Space Station to a branched transportation node space station, and the implications of the accommodation the GEO infrastructure of each type are assessed. Where possible, parametric data are provided to show the implications of variations in sizes and quantities of elements, launch rates, crew sizes, etc. The use of advanced automation, robotics equipment, and an efficient mix of manned/automated support for accomplishing necessary activities at the space station are identified and assessed. The products of this study are configuration sketches, resource requirements, trade studies, and parametric data.

Author

N91-12739# Aerospace Corp., El Segundo, CA. Chemistry and Physics Lab.

PHOTOCHEMICAL SPACECRAFT SELF-CONTAMINATION: LABORATORY RESULTS AND SYSTEMS IMPACTS

Thomas B. Stewart, Graham S. Arnold, David F. Hall, Dean C. Marvin, Warren C. Hwang, Rolaine C. YoungOwl, and H. Daniel Marten 25 Jul. 1990 42 p

(Contract F04701-88-C-0089)

(AD-A226488; TR-0090(5470-01)-3) Avail: NTIS HC/MF A03 CSCL 03/2

It has become clear that photochemical reactions induced by solar vacuum ultraviolet (VUV) radiation play a substantial role in contaminant accretion and effects. A series of laboratory measurements of the absolute rates of adsorption, desorption, and VUV-induced deposition of contaminants have been made under simulated spacecraft conditions. The results of these experiments, together with analyses of operational and experimental flight data, show conclusively that the role of sunlight is not merely to darken or fix previously condensed contaminant films, but also to promote the irreversible deposition of contaminant films under conditions in which condensation would not occur. A simple model of the kinetics of photochemical deposition, based on a competition between desorption and photolysis of a transiently adsorbed contaminant molecule, using experimentally measured parameters, is reasonably successful in describing the deposition process. These laboratory experiments and analyses of space-flight experience reveal that photochemical deposition is significant mechanism whereby contaminant films accrete on orbit and must be considered in the design of future vehicles. GRA

N91-12740# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).

DEVELOPMENT OF A HIGH PERFORMANCE HEAT PIPE FOR THERMAL CONTROL IN FUTURE SPACECRAFT

Robert Mueller (Erno Raumfahrttechnik G.m.b.H. Bremen, Germany, F.R.) 1990 15 p Presented at 7th International Heat Pipe Conference, Binsk, USSR, 21-25 May 1990

(MBB-UO-0090-90-PUB; ETN-90-98157) Avail: NTIS HC/MF A03

The development of a high performance heat pipe design to be used as a thermal bus in medium size platforms and in the radiators of large size space stations is discussed. Circumferential capillary grooves and the separation of the axial fluid flow by an extrusion inserted into the pipe provides the high performance of the heat pipe. In order to demonstrate the feasibility of the concept, two test programs are performed. The first aims to optimize the groove geometry by testing seven evaporator sections in a pumped two phase loop. The test results in maximum heat fluxes of 10.7 W per sq cm and heat transfer coefficients of up to 1.35 W per sq cm K. The second test program is performed on two full scale heat pipes of 1 m length under different tilt conditions. During the tests maximum axial heat loads up to 1200 W with radial heat fluxes of 15.9 W per sq cm are achieved. Under nominal operating conditions the typical heat coefficients are larger than 19.8 per sq cm minus k. ESA

N91-12741# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Space Systems Group.

SPACECRAFT AUTONOMY CONCEPT VALIDATION BY SIMULATION: A FEASIBILITY ASSESSMENT

U. Pape, A. N. Pidgeon (VEGA Space Systems Engineering, Saint-Albans, England), J. Sved, and R. Wilkeit 1990 6 p Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H., Bremen, Fed. Republic of Germany

(MBB-UO-0100-90-PUB; ETN-90-98158) Avail: NTIS HC/MF A02

An assesment of the feasibility of simulating the functionality of an autonomous spacecraft and its ground control system by enhancing a simulator and control system is presented. The distributed, hierarchical onboard architecture based on an earlier ESA study, the Standard Generic Approach to Spacecraft Autonomy and Automation (SGASAA), is described. The architecture uses onboard tools for autonomous replanning and enhanced failure diagnosis. The ground control system will change to enable onboard event reconstruction and the implementation of the autonomous spacecraft simulator will reveal changes in the ground bases missions support role. ESA

N91-12742# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Space Systems Group.

COLUMBUS GENERIC ELEMENT MANAGEMENT AND PLANNING CONCEPT

J. Sved and H. Luttmann 1990 6 p Prepared in cooperation with Erno Raumfahrttechnik G.m.B.H., Bremen, Fed. Republic of Germany

(MBB-UO-0101-90-PUB; ETN-90-98159) Avail: NTIS HC/MF A02

The current status of development of the Columbus onboard autonomous control function concept which is known as the System and Mission Management (SMM) and the complementary execution timeline planning methodology that uses Columbus era computer tools is summarized. It is concluded that the potential exists to condense the documentation tree for payload integration with respect to the operations planning and execution support information by understanding and using the Columbus Generic Element Manager command mechanism and data structure.

ESA

N91-12743# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).

DESIGN, DEVELOPMENT, AND VERIFICATION OF THE EURECA A ORBIT TRANSFER ASSEMBLY (OTA)

H. D. Schmitz and R. Brandt 1990 11 p Previously announced in IAA as A90-42171 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H., Bremen, Fed. Republic of Germany and ESA/ESTEC, Noordwijk, Netherlands

(MBB-UO-0102-90-PUB; ETN-90-98160) Avail: NTIS HC/MF A03

A description of the pressure regulated monopropellant orbit transfer assembly dealing with the design and development of this complex hydrazine propulsion system is presented. The presentation concentrates on various aspects such as functional design, safety aspects, ground verification, multi-mission aspects, in orbit operation, and ground operations and interfaces. Equipment selection, design and development of major components such as propellant tank and 20 N thruster are presented. The overall system

ground acceptance and protoflight qualification tests are described. An outlook with respect to reusability such as flight operation and revalidation of the equipment is presented. ESA

N91-12744# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
MISSION CHARACTERISTICS AND MICROGRAVITY ENVIRONMENT OF THE COLUMBUS FREE FLYING LABORATORY
Wielfried Woehlke and Jens Rohlfsen 1909 12 p Presented at the 39th Raumfahrt-Kongress, HOG, Garmisch-Partenkirchen, Fed. Republic of Germany, 28 Jun. - 1 Jul. 1990 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H., Bremen, Fed. Republic of Germany
(MBB-UO-0105-90-PUB; OTN-030787; ETN-90-98161) Avail: NTIS HC/MF A03

The orbital mission and the low frequency microgravity environment of the Free Flyer are described. This includes mission scenarios, propellant and microgravity budgeting, orbit altitude strategies, rendezvous and berthing of the Free Flyer with Space Station Freedom, and the low frequency acceleration levels at the module to payload rack interface. The potential use of the Free Flyer for carrying out experiments and processes in very low microgravity environments is investigated. ESA

N91-12998# European Space Agency. ESRIN, Frascati (Italy). Earthnet.
MOS-1 Status Report [MOS-1 STATUSREPORT]
Juerg Lichtenegger *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 45-46 In GERMAN (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

N91-13325*# College of William and Mary, Williamsburg, VA. Dept. of Mathematics.
MINIMIZING DISTORTION IN TRUSS STRUCTURES VIA TABU SEARCH
Rex K. Kincaid *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 73-74 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 22B

N91-13342*# West Virginia Univ., Morgantown. Dept. of Electrical and Computer Engineering.
REDUCED-ORDER FILTERING FOR FLEXIBLE SPACE STRUCTURES
Craig S. Sims *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 113-114 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N91-12745# Panametrics, Inc., Waltham, MA.
DEMONSTRATE THE FEASIBILITY OF A DETECTION METHOD TO SEPARATE NEUTRAL PARTICLES FROM CHARGED PARTICLES IN THE MeV/NUCLEON ENERGY RANGE Final Report, Jul. 1988 - Dec. 1989
Bronislaw K. Dichter and Frederick A. Hanser Feb. 1990 44 p
(Contract F19628-87-C-0126; AF Proj. 7601)
(AD-A225656; GL-TR-90-0026; SR-2) Avail: NTIS HC/MF A03 CSCL 18/4

A breadboard model of a spacecraft borne instrument to measure neutral hydrogen atomic fluxes with energies between 1 to 10 MeV/nucleon has been designed, constructed and tested. Differentiation between incident charged and neutral particles was accomplished by measuring the production rate of convoy electrons by the particles. Convoy electron production rate is much larger for neutral hydrogen than for protons. Incident particles strike a thin carbon foil at the entrance aperture and the resulting convoy electrons are deflected by an applied electrostatic field and detected by a micro channel plate detector. The forward going protons are undeflected by the electric field and are detected in a solid state detector. The instrument has been tested with accelerator proton and atomic hydrogen beams of 1.5 to 4 MeV energy. Experimental results and theoretical model calculations are compared. A design for an improved spacecraft instrument is presented. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N91-12746*# Thiokol Corp., Brigham City, UT. Space Operations
FLIGHT MOTOR SET 36OH005 (STS-28R). VOLUME 5: (NOZZLE COMPONENT) Final Report
Dan M. Smith, Jr. Sep. 1990 342 p
(Contract NAS8-30490)
(NASA-CR-184027; NAS 1.26:184027; TWR-17544-5; Publ-90183)
Avail: NTIS HC/MF A15 CSCL 21H

A review of the performance and post flight condition of the STS-28 redesigned solid rocket motor (RSRM) nozzles is presented in this document. Applicable discrepancy reports (DR's) and process departures (PD's) are presented in section 5.0. The nozzle component program team (NCPT) performance evaluation and the redesign program review board (RPRB) assessment is included in section 6.0. The STS-28 nozzle assemblies were flown on the RSRM fifth flight (Space Shuttle Columbia). The nozzles were a partially submerged convergent/divergent movable design with an aft pivot point flexible bearing. The nozzle assemblies incorporated the following features: (1) RSRM forward exit cone with snubber assembly; (2) RSRM fixed housing; (3) structural backup outer boot ring (OBR); (4) RSRM cowl ring; (5) RSRM nose inlet assembly; (6) RSRM throat assembly; (7) RSRM forward nose and aft inlet ring; (8) RSRM aft exit cone assembly with linear-shaped charge (LSC); (9) RTV backfill in joints 1, 3, and 4; (10) use of EA913 NA adhesive in place of EA913; (11) redesigned nozzle plug; and (12) carbon cloth phenolic (CCP) with 750 ppm sodium content. The RSRM fifth flight test objectives are as follows: (1) verify that flexible bearing seals operate within the specified temperature range; (2) verify that flexible bearing maintained a positive gas seal between its internal components; (3) inspect flexible bearing for damage due to water impact; (4) verify performance of the nozzle liner; (5) verify that nozzle parts are reusable; (6) verify through flight demonstration and a postflight inspection that the flexible bearing is reusable; (7) verify by inspection the remaining nozzle ablative thicknesses; and (8) verify the nozzle performance margins of safety. Author

N91-12747*# Thiokol Corp., Brigham City, UT. Space Operations.
SPACE SHUTTLE DEVELOPMENT MOTOR NO. 9 (DM-9), VOLUME 1
Diane M. Garecht Sep. 1990 563 p
(Contract NAS8-30490)
(NASA-CR-184029; NAS 1.26:184029; TWR-17371-Rev-A; Publ-910335) Avail: NTIS HC/MF A24 CSCL 22B

The results obtained during the December 23, 1987 static firing of the DM-9 test article are presented. The DM-9 full-scale static test article employed redesigned solid rocket motor (RSRM)

field joint capture feature hardware with J-seal insulation configuration, and nozzle-to-case joint radial bolt design with bonded insulation configuration. The nozzle incorporated RSRM components, including a thicker cowl with involuted outer boot ring. The nozzle employed redundant and verifiable seals in all five joints, and room temperature vulcanization backfill in three joints. With very few exceptions, the DM-9 test article was flight configuration. The test was conducted under extreme weather conditions: temperature of 25 F and wind at 15 to 20 mph. Ballistics performance values were within specification requirements. The RSRM field joint (J-seal) insulation configuration functioned as predicted with no indication of hot gases reaching the capture feature O-rings. There was a blowhole in the polysulfide adhesive in the nozzle-to-case joint, but no evidence of hot gases past the wiper O-ring. Nozzle design changes appeared to perform nominally, with the exception of the outer boot ring, which suffered partial structural breakup late in the test. Field joint heaters maintained the controlling resistance temperature device temperature within the specified requirements during heater operation. The thrust vector control system operated properly. The redesigned water deluge system, temperature conditioning equipment, and other test support equipment performed as planned. Author

N91-12748*# Martin Marietta Corp., Denver, CO. Astronautics Group.
SPACE STATION AUTOMATION OF COMMON MODULE POWER MANAGEMENT AND DISTRIBUTION, VOLUME 2 Final Report
B. Ashworth, J. Riedesel, C. Myers, L. Jakstas, and D. Smith Jul. 1990 463 p
(Contract NAS8-36433)
(NASA-CR-184035; NAS 1.26:184035; MCR-89-516-Vol-2) Avail: NTIS HC/MF A20 CSCL 22B

The new Space Station Module Power Management and Distribution System (SSM/PMAD) testbed automation system is described. The subjects discussed include testbed 120 volt dc star bus configuration and operation, SSM/PMAD automation system architecture, fault recovery and management expert system (FRAMES) rules english representation, the SSM/PMAD user interface, and the SSM/PMAD future direction. Several appendices are presented and include the following: SSM/PMAD interface user manual version 1.0, SSM/PMAD lowest level processor (LLP) reference, SSM/PMAD technical reference version 1.0, SSM/PMAD LLP visual control logic representation's (VCLR's), SSM/PMAD LLP/FRAMES interface control document (ICD) , and SSM/PMAD LLP switchgear interface controller (SIC) ICD. Author

N91-12749*# Thiokol Corp., Brigham City, UT. Space Operations.
FLIGHT MOTOR SET 360L009 (STS-36). VOLUME 1: SYSTEM OVERVIEW Final Report
Diane M. Garecht Sep. 1990 176 p
(Contract NAS8-30490)
(NASA-CR-184041; NAS 1.26:184041; TWR-17548-Vol-1; Publ-90537) Avail: NTIS HC/MF A09 CSCL 21H

Flight Motor Set 360L009, as part of NASA Space Shuttle Mission STS-36, a Department of Defence mission, was launched after two launch attempts. One launch was scrubbed following the failure of a ground-based Range Safety computer and one was scrubbed due to cloud cover at the return to launch landing site. As with all previous redesigned solid rocket motor launches, overall motor performance was excellent. There were no debris concerns from either motor. All ballistic and mass property parameters that could be assessed, closely matched the predicted values and were well within the required contract item specification levels. All field joint heaters and igniter joint heaters performed without anomalies. Evaluation of the ground environment instrumentation measurements again verified thermal model analysis data and showed agreement with predicted environmental effects. No launch commit criteria violations occurred. Postflight inspection again verified nominal performance of the insulation, phenolics, metal parts, and seals. Postflight evaluation indicated that both nozzles performed as expected during flight. All combustion gas was contained by insulation in the field and case-to-nozzle joints. Recommendations were made concerning improved thermal modeling and measurements. The rationale for these recommendations and complete result details are presented. Author

N91-12750# Army Construction Engineering Research Lab., Champaign, IL.
NONDESTRUCTIVE EVALUATION AND INSPECTION PROGRAMS FOR PERSHING 2 MOTORS Final Report
Robert B. Moler, Frank W. Kearney, and Mark D. Ginsberg Jun. 1990 42 p
(AD-A225009; CERL-TR-M-90/16) Avail: NTIS HC/MF A03 CSCL 14/2

Quality control inspection of Pershing II (P-II) solid-propellant rocket motors was historically the responsibility of the manufacturer. Now the U.S. Army Pueblo Depot Activity (PDA) has been assigned the task of nondestructive evaluation and inspection (NDE/NDI) of P-II motors returned from the field. The purpose of this study was to make recommendations for upgrading PDA's inspection capabilities. Its procedures and facilities were reviewed, as were the inspection requirements of field-returned P-II motors. Advanced techniques such as computed tomography (CT) and real-time radiography (RTR) were evaluated, and experimental ultrasound and thermography techniques were reviewed. The study recommended modification of existing inspection procedures and installation of an advanced RTR system, including a modification of motor-handling equipment. The existing betatron appeared to be a suitable x ray source. Also recommended were a borescope, to inspect aspects of the solid fuel, and a thickness gage. CT was rejected because it cost more than RTR without increasing inspection capabilities and would require extensive modification or replacement of existing facilities. Although potentially useful, advanced ultrasound methods are still at the experimental stage and could not be recommended. However, an advanced thermography system was found to be immediately applicable for detecting subsurface anomalies. GRA

N91-12751# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
SOLID PROPELLANT BALLISTIC MISSILE (REFERENCES)
A. M. Sinyukov and L. I. Volkov 27 Jun. 1990 15 p Transl. into ENGLISH from Ballisticheskaya Raketa na, Tverdom Topliv (USSR), 1972 p 502-507
(AD-A225308; FTD-ID(RS)T-0487-90) Avail: NTIS HC/MF A03 CSCL 21/8

The major areas covered include: design and testing of ballistic missiles; mechanical properties of structural materials; studies of solid propellant rocket engines; and applications of mathematics in various areas of missile design. Approximately 160 references are cited. Y.S.

N91-12526# Nagoya Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL SIMULATION ON INVERSE JET OF SOLID ROCKET MOTOR
Koichi Hayashi and Minoru Matsuda (Mitsubishi Heavy-Industries Ltd., Nagoya, Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 81-85 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

23 CHEMISTRY AND MATERIALS (GENERAL)

N91-12752# Oak Ridge National Lab., TN. Energy Div.
ADVANCED MATERIALS: INFORMATION AND ANALYSIS NEEDS
T. Randall Curlee, Sujit Das, Russell Lee, and David Trumble Sep. 1990 85 p
(Contract DE-AC05-84OR-21400)
(DE91-001017; ORNL/TM-11593) Avail: NTIS HC/MF A05

This report presents the findings of a study to identify the types of information and analysis that are needed for advanced materials. The project was sponsored by the U.S. Bureau of Mines (BOM). It includes a conceptual description of information needs for advanced materials and the development and implementation of a questionnaire on the same subject. This report identifies twelve fundamental differences between advanced and traditional materials and discusses the implications of these differences for data and analysis needs. Advanced and traditional materials differ significantly in terms of physical and chemical properties. Advanced material properties can be customized more easily. The production of advanced materials may differ from traditional materials in terms of inputs, the importance of by-products, the importance of different processing steps (especially fabrication), and scale economies. The potential for change in advanced materials characteristics and markets is greater and is derived from the marriage of radically different materials and processes. In addition to the conceptual study, a questionnaire was developed and implemented to assess the opinions of people who are likely users of BOM information on advanced materials. The results of the questionnaire, which was sent to about 1000 people, generally confirm the propositions set forth in the conceptual part of the study. The results also provide data on the categories of advanced materials and the types of information that are of greatest interest to potential users. DOE

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N91-12753# Bureau of Mines, Washington, DC.
NEW MATERIALS SOCIETY: CHALLENGES AND OPPORTUNITIES. VOLUME 1: NEW MATERIALS MARKETS AND ISSUES
1990 156 p
(PB90-255498) Avail: NTIS HC/MF A08; also available SOD HC $8.50 as 024-004-02211-6 CSCL 11D

A comprehensive report on the subject on advance materials is presented. The current state of affairs in the U.S. materials industry is discussed with particular emphasis on recent technology advances in materials. The information presented reflects the state of the industry in 1988 and contains the best information available during that time. The analysis was based upon discussions with many public and private sector experts in materials science, engineering, product application, and upon extensive literature surveys. The following are topics by chapter: (1) General Introduction; (2) Markets for New Materials; and (3) Analysis of New Materials Issues. GRA

N91-12754# Bureau of Mines, Washington, DC.
NEW MATERIALS SOCIETY: CHALLENGES AND OPPORTUNITIES. VOLUME 2: NEW MATERIALS SCIENCE AND TECHNOLOGY
1990 294 p
(PB90-255506) Avail: NTIS HC/MF A13; also available SOD HC $15.00 as 024-004-02212-4 CSCL 11D

A comprehensive report on the subject of advanced materials is presented. The report discusses the current state of affairs in the U.S materials industry with particular emphasis on recent technology advances in materials. The information presented reflects the state of the industry in 1988 and contains the best information available during that time. The analysis was based upon discussions with many public and private sector experts in materials science, engineering, product application, and upon extensive literature surveys. The following are topics by chapter: (4) New Materials Technology Overview; (5) Advanced Metals; (6) Metal Matrix Composites; (7) Advanced Ceramic Materials; and (8) Advance Polymer Materials. GRA

N91-12755 Delaware Univ., Newark.
PROCESS-INDUCED STRESS AND DEFORMATION IN THICK-SECTION THERMOSETTING COMPOSITES Ph.D. Thesis
Travis Anthony Bogetti 1989 327 p
Avail: Univ. Microfilms Order No. DA9019318

The cure and process-induced stress and deformation development in thick-section thermosetting composites is presented. A two-dimensional anisotropic cure simulation analysis is developed to predict temperature and degree of cure distributions within arbitrary cross-sectional geometries as a function of the autoclave temperature history. Correlation between experimentally measured and predicted through-the-thickness temperature profiles in glass/polyester laminates are presented for various arbitrary temperature cure cycle histories. Several typical glass/polyester and graphite/epoxy structural elements of arbitrary cross-section are analyzed. Spatial gradients in degree of cure are shown to be strongly dependent on part geometry, thermal anisotropy, cure kinetics, and the autoclave temperature cure cycle. The cure simulation analysis is coupled to an incremental laminated plate theory model and a quasi-three-dimensional finite element analysis to study the complex relationships between gradients in temperature and degree of cure and process-induced stress and deformation unique to thick sections. Material models are developed to describe composite behavior during cure. Thermal expansion and cure shrinkage contribute to changes in material specific volume and represent important sources of internal loading included in the analysis. The effects of the autoclave temperature cure cycle, laminate thickness, resin shrinkage and laminate stacking sequence on the evolution of processing-induced stress and deformation are presented. Significant macroscopic stresses are shown to develop during the curing process of thick-section laminates. The results presented demonstrate that the mechanics and performance of thick-section thermosets are strongly dependent on processing history. Dissert. Abstr.

N91-12756 Georgia Inst. of Tech., Atlanta.
MICROMECHANICAL STUDIES OF CRACK GROWTH IN A CERAMIC MATRIX COMPOSITE Ph.D. Thesis
Jed Scott Lyons 1990 205 p
Avail: Univ. Microfilms Order No. DA9031267

The interrelationships between the fracture mechanisms of short fiber-reinforced slip-cast fused silica matrix composites and the properties of the fiber and of the fiber to matrix interface are explored. The approach taken combined experimental mechanical property determinations and fracture surface analyses with finite element microstructural modeling. Composites were formed by incorporating short, randomly oriented aluminoborosilicate fibers in a silica/water suspension, slip-casting, and sintering. The ambient and 1000 C flexural strengths, plane strain fracture toughness, fracture surface energy, and crack resistance curves were determined for each material. Quantitative fractography and scanning electron microscopy were employed to determine the fracture origins and paths. Interface strengths were evaluated by fiber micro-indentation testing. The results indicated that fiber reinforcements which were weakly bonded to the matrix improved the fracture resistance of the slip cast fused silica matrix, with a slight loss in the material stiffness and strength. These composites exhibited rising crack growth resistance curves, and up to a two-fold increase in the fracture surface energy. In the second part of this research, a two-dimensional finite element model for crack growth was developed, in which individual microstructural parameters are

varied. This permitted the isolation of the effects of each feature on the composite's fracture behavior. Fracture paths were predicted for isolated fibers at discrete orientations with respect to the crack plane. Increases in material toughness were determined by calculating the strain energy release rate after each increment of crack growth. Results indicated that the fracture process is strongly influenced by the fiber orientation, the residual stress state, and the strength of the fiber to matrix interface bond. Dissert. Abstr.

N91-12757# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Dienstleistungsbereich.

INVESTIGATIONS ON THE INTERFACE AND MECHANICAL PROPERTIES OF COMPOSITES BASED ON NON IMPREGNATED CARBON FIBRE REINFORCED THERMOPLASTIC PREFORMS

M. Nardin, E. M. Asloun, J. Schultz (Centre National de la Recherche Scientifique, Mulhouse, France), J. Brandt, and H. Richter 1990 14 p Presented at 11th International SAMPE Conference, Basel, Switzerland, 29-31 May 1990 Sponsored by EEC

(MBB-Z-0298-90-PUB; ETN-90-97880) Avail: NTIS HC/MF A03

The processing, interface characteristics and mechanical performance of carbon fiber reinforced thermoplastic (PEEK) composites are investigated. Results of mechanical tests on different systems obtained from thermoplastic/carbon fibers hybrid fabrics are presented. Special focus is directed on evaluation of the interfacial shear strength at the carbon fiber-PEEK interface by means of a fragmentation test on the respective single fiber composites. In each case, the results are compared to the magnitude of the fiber/matrix adhesion, estimated from the surface properties (surface energy and acid-base characteristics) of both materials. ESA

N91-12758# Berkeley Applied Science and Engineering, Oakland, CA.

DEVELOPMENT OF AN ADVANCED CONTINUUM THEORY FOR COMPOSITE LAMINATES, PHASE 1 Final Report, 1 Nov. 1989 - 30 Jun. 1990

G. R. Ghanimati, M. Panahandeh, and Y. Bozorgnia 27 Jun. 1990 259 p

(Contract F49620-90-C-0001; AF Proj. 3005)

(AD-A224985; RG-03-89; AFOSR-90-0781TR) Avail: NTIS HC/MF A12 CSCL 11/4

A continuum theory for laminated composite materials, referred to as Cosserat Composite Theory, was developed. The theory is represented by a set of well defined conservation laws that within the context of purely mechanical theory exhibits the following features: (1) it accounts for the effect of microstructures; (2) it accounts for the effect of geometric nonlinearity; (3) it accounts for the interlaminar stresses and therefore delamination can be considered; (4) it is capable of incorporating the effect of material nonlinearity; (5) it accounts for the effect of curvature; (6) it possesses a continuum character; and finally (7) it is applicable to both static and dynamic problems. The composite laminate was modeled as a series of Cosserat surfaces which were considered as microstructures. Various quantities associated with the microstructure were defined and the corresponding quantities for composite laminates were derived. The nonlinear constitutive equations for an elastic composite laminate are presented. GRA

N91-12759# Texas A&M Univ., College Station. Dept. of Civil Engineering.

SIMPLIFICATIONS IN THE BEHAVIOR OF VISCOELASTIC COMPOSITES WITH GROWING DAMAGE

R. A. Schapery Jul. 1990 17 p

(Contract N00014-89-J-3012)

(AD-A225788; MM-27010-90-8) Avail: NTIS HC/MF A03 CSCL 11/4

Some analytical results for the mechanical behavior of elastic composite materials and structures with growing damage are summarized and then extended to viscoelastic media. The effect of strain rate at crack tips is considered first; it is shown that if the crack speed is a strong function of energy release rate, the overall mechanical response is like that for an aging elastic material. Both stable crack growth and unstable crack growth followed by arrest produce this aging-like behavior. Viscoelastic behavior throughout one or more of the phases is then introduced. A simplification is used in which only one relaxation modulus characterizes the viscoelasticity, apart from that at crack tips. Upon replacing the physical displacements in the response for an elastic material by quantities called pseudo displacements, a simple model for viscoelastic composites with growing damage is obtained. GRA

N91-12760# Colorado State Univ., Fort Collins. Dept. of Chemistry.

ION-TRANSPORTING COMPOSITE MEMBRANES. PART 3: SELECTIVITY AND RATE OF ION TRANSPORT IN NAFION (TM) IMPREGNATED GORE-TEX MEMBRANES PREPARED BY A HIGH TEMPERATURE SOLUTION-CASTING METHOD

Chao Liu and Charles R. Martin 2 Aug. 1990 39 p Submitted for publication Sponsored in part by AF

(Contract N00014-82-K-0612)

(AD-A225837; TR-50) Avail: NTIS HC/MF A03 CSCL 11/4

In a previous paper we discussed the rate of ion-transport in Nafion Impregnated Gore-Tex (NIGT) membranes. The membranes described in this previous paper were prepared by immersing the Gore-Tex in a solution of Nafion and then allowing the solvent to evaporate at room temperature. Nafion films which are cast at room temperature show poor mechanical and transport properties. This paper describes the transport properties of NIGT membranes prepared via a high temperature solution-casting method. We have found that these high temperature-cast NIGT membranes show better physical and mechanical properties than the low temperature-cast NIGT investigated previously. The two diffusion-pathway mode, described in the previous paper, quantitatively accounts for the transport data for the high temperature-cast membranes. GRA

N91-12761# United Technologies Research Center, East Hartford, CT.

INTERFACIAL STUDIES OF WHISKER AND COATED FIBER REINFORCED CERAMIC MATRIX COMPOSITES Annual Report, May 1989 - May 1990

John Brennan 31 May 1990 95 p

(Contract F49620-88-C-0062)

(AD-A226020; AFOSR-90-0857TR) Avail: NTIS HC/MF A05 CSCL 11/4

The objectives of this program are to characterize the interfacial region in a variety of whisker and coated fiber reinforced glass ceramic matrix composites, and to study how the structure, chemistry, and bonding characteristics of the interface influence composite properties such as strength, toughness, and environmental and thermal stability. During the past year, efforts in the whisker composite area were focused on the investigation of whisker coatings such as carbon and boron nitride, BN, on lithium aluminum silicate (LAS) glass ceramic matrix composite properties, fabrication and characterization of calcium aluminosilicate (CAS) matrix/SiC whisker composites, high resolution TEM studies of a variety of techniques, and the evaluation of SiC platelets as an alternate reinforcement to whiskers. Efforts in the coated fiber area were focused on the evaluation of yttria and BN coated NICALON fibers from General Atomics. Results of these studies are presented. GRA

N91-12762# Materials Sciences Corp., Blue Bell, PA.

STRUCTURAL DEVELOPMENT OF MICRO-STRUCTURALLY TOUGHENED METAL MATRIX COMPOSITES Final Technical Report, 1 Sep. 1989 - 30 Jun. 1990

Edward C. Wung and Kent W. Buesking 30 Jun. 1990 69 p

(Contract N00014-89-C-0210)

(AD-A226060; MSC-TFR-2111/8602) Avail: NTIS HC/MF A04 CSCL 11/4

This study addressed the development of a new class of discontinuously reinforced metals that possess substantially improved damage tolerance relative to the currently available

materials. The novelty is to allow specially designed toughening mechanisms to be operative in the composites. Technical effort of this study focused on developing a fundamental understanding of the toughening mechanisms at the micromechanics level, and identifying possible SDI structural components that can be improved through the use of this material. This goal was achieved by the development of two microchemical material models. The first model addressed the stress-strain constitutive modeling, and the second model addressed the modeling of fracture toughness of the new composites. GRA

N91-12763# Oak Ridge National Lab., TN. Metals and Ceramics Div.

STRESS-DISPLACEMENT RELATION DURING FIBER PULLOUT

C. H. Hsueh 1990 7 p Presented at the 2d International Ceramic Science and Technology Congress Symposium on Glasses for Electronic Applications, Orlando, FL, 12-15 Nov. 1990

(Contract DE-AC05-84OR-21400)

(DE91-000392; CONF-901125-2) Avail: NTIS HC/MF A02

During fiber pullout tests of fiber-reinforced composites, initial debonding, partial debonding, complete debonding at the interface, and fiber pullout occur sequentially. Adopting the shear lag model for stress analyses and the strength criterion for interfacial debonding, a bond length dependence of the initial debond stress is derived. During partial debonding, the stress initially increases with the increasing fiber displacement. The partial debond stress reaches a maximum value and begins to decrease with an accompanying decreasing fiber displacement until the interface is completely debonded. Theoretically, the stress-displacement curve shows a nose at the maximum debond stress. However, the pullout test is generally conducted under the condition of an increasing fiber displacement. Hence, at the maximum debond stress, the observed stress drops abruptly as the increasing fiber displacement type test obscures the nose-type characteristic. DOE

N91-12764# Georgia Tech Research Inst., Atlanta. Energy and Materials Sciences Lab.

DEVELOPMENT OF CONTINUOUS FIBER REINFORCED SILICON NITRIDE

T. L. Starr, J. N. Harris, D. L. Mohr, and J. S. Lyons Aug. 1990 21 p Prepared for Oak Ridge National Lab., TN

(Contract DE-AC05-84OR-21400; ORNL Order 19X-00184C)

(DE91-001156; ORNL/Sub-87-00184/02) Avail: NTIS HC/MF A03

Ceramic composites continue to offer great promise for increasing the efficiency of fossil fuel utilization. One particular application is for gas turbine components utilizing a direct combustion or gasification/combustion process. Turbine components have to maintain their structural integrity at high temperatures and under aggressive chemical environments. Fiber-reinforced ceramics offer increased toughness and damage tolerance while maintaining the high temperature capability and chemical stability inherent in ceramic materials. Our efforts have focused on fabrication of composites using ultrafine silicon powders prepared by attritor milling. This powder shows near full conversion in less than three hours with a maximum temperature of 1200 C. These processing conditions are suitable for composites using polymer-derived ceramic fibers. Composites were fabricated by infiltrating ceramic fiber cloths with a slurry of attritor milled silicon in ethanol. Several layers of cloth were stacked and compressed with alternating 0 to 90 deg orientation to form a plate-shaped green body. The final composite was formed by heating in a nitrogen atmosphere with a temperature ramp up to 1200 C and a total processing time of less than three hours. DOE

N91-12765# Sandia National Labs., Albuquerque, NM. Ceramics Development Div.

SINTERING MAPS FOR CERAMIC-FILLED-GLASS COMPOSITES

K. G. Ewsuk 1990 12 p Presented at the 2nd International Ceramic Science and Technology Congress Symposium on Glasses for Electronic Applications, Orlando, FL, 12-15 Nov. 1990

(Contract DE-AC04-76DP-00789)

(DE91-001229; SAND-90-1675C; CONF-901125-3) Avail: NTIS HC/MF A03

Ceramic-filled-glass (CFG) composites densify by viscous flow during final-stage, non-reactive, liquid-phase sintering (NLPS). The rate of densification is controlled by the viscosity of the CFG composite dispersion during sintering, which is determined by the concentration of ceramic filler in the composite, and the viscosity of the suspending glass medium. A mathematical expression has been developed that determines the critical filler concentration in a given viscosity glass at which high-density CFG composites will be produced in a given time during final-stage NLPS. This expression has been used to predict the effects of sintering time, pore size, and glass viscosity on critical filler concentration, and to construct final-stage sintering maps that provide guidelines for designing and processing high-density CFG composites. DOE

N91-12766# Oak Ridge National Lab., TN. Metals and Ceramics Div.

CHARACTERIZATION AND CONTROL OF THE FIBER-MATRIX INTERFACE IN CERAMIC MATRIX COMPOSITES

R. A. Lowden Mar. 1989 199 p

(Contract DE-AC05-84OR-21400)

(DE91-000922; ORNL/TM-11039) Avail: NTIS HC/MF A09

Fiber-reinforced SiC composites fabricated by thermal-gradient forced-flow chemical-vapor infiltration (FCVI) exhibited both composite (toughened) and brittle behavior during mechanical property evaluation. Detailed analysis of the fiber-matrix interface revealed that a silica layer on the surface of Nicalon-Si-C-O fibers tightly bonds the fiber to the matrix. The strongly bonded fiber and matrix, combined with the reduction in the strength of the fibers that occurs during processing, resulted in the observed brittle behavior. The mechanical behavior of Nicalon/SiC composites was improved by applying thin coatings (silicon carbide, boron, boron nitride, molybdenum, carbon) to the fibers, prior to densification, to control the interfacial bond. Varying degrees of bonding were achieved with different coating materials and film thicknesses. Fiber-matrix bond strengths were quantitatively evaluated using an indentation method and a simple tensile test. The effects of bonding and friction on the mechanical behavior of this composite system were investigated. DOE

N91-12767*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

DETERMINATION OF FIBER VOLUME IN GRAPHITE/EPOXY MATERIALS USING COMPUTER IMAGE ANALYSIS

Michael J. Viens Washington Nov. 1990 11 p

(NASA-TM-100770; Rept-91B00019; NAS 1.15:100770) Avail: NTIS HC/MF A03 CSCL 11D

The fiber volume of graphite/epoxy specimens was determined by analyzing optical images of cross sectioned specimens using image analysis software. Test specimens were mounted and polished using standard metallographic techniques and examined at 1000 times magnification. Fiber volume determined using the optical imaging agreed well with values determined using the standard acid digestion technique. The results were found to agree within 5 percent over a fiber volume range of 45 to 70 percent. The error observed is believed to arise from fiber volume variations within the graphite/epoxy panels themselves. The determination of ply orientation using image analysis techniques is also addressed. Author

N91-12768# Pennsylvania State Univ., University Park. Materials Research Lab.

STUDIES IN WAVE-MATERIAL INTERACTION AND DESIGN OF COMPOSITE MATERIALS Final Report

10 Aug. 1990 104 p

(Contract N00014-87-K-0031)

(AD-A226422) Avail: NTIS HC/MF A06 CSCL 11/4

The thrust of this project is to come up with the design and specification of advanced composite materials using dielectric ceramics, chiral polymers or piezoelectric materials as inclusions with polymer-based materials as the binders. The research is

theoretical and complements the associated experimental and developmental programs on such materials at the Research Center for the Engineering of Electronic and Acoustic Materials and the Materials Research Laboratory. Basic research on the interaction of electromagnetic and acoustic fields with composite materials at wavelengths comparable to inclusion size and spacing were to be studied to come up with structure-property relations that offer better possibilities for controlling material behavior than those permitted by simple mixing rules. Emphasis was on chiral composites, piezoelectric composites, fractal composites, and ferrite composites. GRA

N91-12769# Drexel Univ., Philadelphia, PA. Fibrous Materials Research Lab.
STRUCTURE AND PROPERTIES OF HIGH SYMMETRY COMPOSITES Final Report, 1 Dec. 1987 - 30 Nov. 1990
Frank K. Ko, Albert S. D. Wang, Charles Lei, Eileen A. Carroll, and Yun Jia Cai 27 Jul. 1990 270 p
(Grant AF-AFOSR-0075-88; AF Proj. 2306)
(AD-A226479; Rept-010004-1; AFOSR-90-0873TR) Avail: NTIS HC/MF A12 CSCL 11/2

This report describes the concept formulation and demonstration for high symmetry composites by examination of the combination of spheres in 3-D fiber architectures. By computer simulation, the level of geometric symmetry composites, a finite cell model and a finite element code for the analysis of sphere have been developed. A method for the fabrication of the high symmetry system has also been developed. GRA

N91-12770# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
MBB-LAGRANGE: STRUCTURAL OPTIMIZATION SYSTEM FOR SPACE AND AIRCRAFT STRUCTURES
Guenter Kneppe 28 Jun. 1990 22 p Presented at COMMETT Seminar on Computer Aided Optimal Design, Bayreuth, Fed. Republic of Germany, 1990
(MBB/FW522/S/PUB/406; ETN-90-98156) Copyright Avail: NTIS HC/MF A03

The structural optimization system MBB-LAGRANGE allows the optimization of homogeneous isotropic, orthotropic or anisotropic structures as well as fiber reinforced materials with respect to weight, static, dynamic, aeroelastic, and manufacturing requirements. Design variables are sizing and geometric dimensions. The highlights are the treatment of large scale problems and especially the simultaneous optimization of different disciplines. Development is focused on three main topics: optimization models, structural analysis with sensitivity analysis, and optimization algorithms. Integration into the computer aided engineering environment is important for practical applications. ESA

N91-12771# Max-Planck-Inst. fuer Metallforschung, Stuttgart (Germany, F.R.). Inst. fuer Werkstoffwissenschaft.
MANUFACTURING OF SiC WHISKER REINFORCED SIN4 BY A COMBINED SINTER HIP PROCESS Ph.D. Thesis - Stuttgart Univ. [HERSTELLUING VON SIC-WHISKERVERSTAERKTEM SI3N4 DURCH EIN KOMBINIERTES SINTER-HIP-VERFAHREN]
Michael Johannes Hoffmann 1989 188 p In GERMAN
(ETN-90-98162) Avail: NTIS HC/MF A09

The manufacturing of SiC whisker reinforced Ci3N4 by a combined sinter and HIP (Hot Isostatic Pressing) process was addressed. SiC-whiskers were characterized by raster electron microscopy and separated by sedimentation in a watery solution in two size classes. By measurements of the zeta potential of the whisker with variation of the pH, the optimal area was found for the stabilization of the watery suspensions. A comparison between the zeta potential profile of the used Si3N4 powder and the SiC-whisker showed that they have a similar structure surface. The rheologic examinations did not show an influence of the SiC-whisker on the viscosity and fluidity. Samples were made with sinter additives and showed a strong anisotropy. ESA

N91-13318*# Wichita State Univ., KS. Dept. of Aerospace Engineering.
EDGE DELAMINATION OF COMPOSITE LAMINATES SUBJECT TO COMBINED TENSION AND TORSIONAL LOADING
Steven J. Hooper *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 58-59 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 11D

N91-13327*# Pennsylvania State Univ., University Park. Dept. of Engineering Science and Mechanics.
MICROCRACKING MECHANISMS AND INTERFACE TOUGHENING OF SEMI-IPN POLYIMIDE MATRIX COMPOSITES
Byung L. Lee and R. Pater *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 77-78 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N91-12772 ESDU International Ltd., London (England).
SUMMARY TABLES Abstract Only
May 1990 159 p
(ESDU-PD4; ISBN-0-85679-733-2; ISSN-0141-4070) Avail: ESDU

The equations and tabulated values are presented by ESDU PD4 for the saturation line thermodynamic properties of liquid C1 to C18 straight-chain alkanes (and four isomers) and C2 to C14 straight-chain alkenes (and one isomer). The data are brought together from other documents in the Sub-series that treat of one property alone, so as to provide a convenient source of reference in a standard format. The original data resulted from a critical evaluation of experimental values extracted from the literature, and the earlier documents discuss the evaluation methods and indicate all the sources of data used. Values are tabulated from the melting point to the critical point, or as near as is reasonably practical, for density, dynamic viscosity, thermal conductivity, isobaric heat capacity, and vapor pressure. The values are calculated at 10 C and 10 K intervals using polynomial equations fitted to the data for each property for each compound, and the coefficients of the equations are also provided. ESDU

N91-12773 ESDU International Ltd., London (England).
THERMOPHYSICAL PROPERTIES OF SULPHUR DIOXIDE Abstract Only
Feb. 1990 17 p
(ESDU-90003; ISBN-0-85679-727-8; ISSN-0141-4062; ISSN-0141-4070) Avail: ESDU

ESDU 90003 gives equations obtained from a critical evaluation of experimental data in the literature for the variation along the saturation line with temperature, for both the liquid and the vapor, of: density, enthalpy, heat capacity at constant pressure, dynamic viscosity and thermal conductivity. Also given are equations for the variation with temperature along the saturation line of the vapor pressure, latent heat of vaporization and surface tension, together with equations for the variation with temperature for the ideal gas of specific heat capacity at constant pressure, enthalpy, dynamic viscosity, and thermal conductivity. Results on the saturation line evaluated in SI units using the equations are tabulated at 5 K intervals from the melting point to the critical point, or as close to it as possible for some properties. Results for the ideal gas evaluated also in SI units using the equations are tabulated at 10 K intervals from the melting point to 1000 K.

In the absence of experimental values some of these results involve extrapolation and they are indicated in the tables. ESDU

N91-12774 Princeton Univ., NJ.
THEORY OF PREMIXED FLAME PROPAGATION IN LARGE-SCALE TURBULENCE Ph.D. Thesis
Ralph Curtis Aldredge, III 1990 148 p
Avail: Univ. Microfilms Order No. DA9027537

An investigation into the feedback between a downward-propagating laminar premixed flame and a turbulent flow of low intensity and large length scale is presented. Closed-form, analytical expressions are obtained at the leading order for the turbulent burning velocity, variation of turbulent kinetic energies, and root-mean-square vorticity fluctuations. These expressions involve the character of the excitation turbulence introduced far upstream-its integral length scale, intensity, and autocorrelation function-and aspects of the chemically-reactive flow. Calculations show that a finite value of the turbulence length scale gives the greatest turbulent burning velocity. Also, gas expansion across the flame is found to enhance flame wrinkling and give greater turbulent flame speeds. It is shown how buoyancy counteracts the tendency for gas expansion to increase transverse components of the turbulent flame speeds. It is shown how buoyancy counteracts the tendency for gas expansion to increase transverse components of the turbulent kinetic energy, pressure fluctuations, and vorticity generation across the wrinkled flame. Strong readjustments in turbulent kinetic energy components are shown to occur in the downstream hydrodynamic zone. It is established that the flame can induce anisotropy in initially isotropic turbulence. An iteration method is formulated for obtaining series solutions to the fully nonlinear feedback problem. It is shown that coefficients of odd powers of intensity in the series solutions are zero for excitation fields which are isotropically turbulent or periodic, so that solutions of the nonlinear problem describing turbulent kinetic energy profiles and the turbulent burning velocity are expected to depend on the square of the turbulence intensity of the excitation field for these cases. Dissert. Abstr.

N91-12775 California Univ., Berkeley.
NITROUS OXIDE COMBUSTION CHEMISTRY Ph.D. Thesis
Richard John Martin 1989 178 p
Avail: Univ. Microfilms Order No. DA9028950

To gain improved understanding of N2O combustion chemistry, experimentation and numerical modeling were performed, and are described. Principal conclusions are: (1) N2O emission is quite temperature dependent, and (2) for lean, homogeneous combustion systems with peak temperatures higher than 1200 K and without rapid cooling, N2O emission is low. Thermochemical property variations have substantial effects on calculated species profiles. Changes in enthalpies of formation of NH, NH2, and NNH resulted in large differences in predicted NO, N2, and N2O concentrations. Measurements were made in lean, premixed, and atmospheric pressure flat flames by microprobe sampling and gas chromatographic or chemiluminescence analysis. With 2000 ppm of either NH3, NO, or N2O added to the reactants, N2O was observed at moderate concentrations near the burner surface, and a monotonically decreasing concentrations downstream. With NH3 as dopant, early- and post-flame N2O concentration varied inversely with temperature, as did its decay rate. With N2O as dopant, product branching to NO and N2 was 8 and 92 percent. Sensitivity and rate data indicated the primary N2O formation and destruction reactions to be NH + NO = N2O + H and H + N2O = N2 + OH, and that H + O2 + M = HO2 + M plays an important role in trapping H atoms to enhance N2O survival. Flash-ignited combustion experiments were performed and studied. A mixture, where NH3 was primary photolysis absorber and fuel species, burned inhomogeneously. Concentration profiles of N2, NO, O2, and N2O were recorded. N2O added to the reactants disappeared during combustion. Post-flame NO and N2 concentrations were higher than previously reported NH3 flames, but their ratio agreed well with earlier results. Dissert. Abstr.

N91-12776# Rice Univ., Houston, TX. Dept. of Chemistry.
AMMONIA CHEMISORPTION STUDIES ON SILICON CLUSTER IONS Interim Technical Report
J. M. Alford, R. T. Laaksonen, and R. E. Smalley 23 Jul. 1990 46 p
(Contract N00014-88-K-0553)
(AD-A224949; TR-4) Avail: NTIS HC/MF A03 CSCL 07/4

Silicon clusters in the size range from 5 to 66 atoms were generated by laser vaporization in a supersonic nozzle and injected into the ion trap of a specially-designed Fourier transform ion cyclotron resonance apparatus. On the positively charged clusters ammonia chemisorption reaction rates were found to vary by over three orders of magnitude as a function of cluster size, with clusters of 21, 25, 33, 39, and 45 atoms being particularly unreactive, and cluster 43 being the most reactive. For the negative cluster ions, 43 was the only cluster found to react substantially. Although the reaction behavior of many clusters clearly indicated that several structural isomers were present with different reaction rates, the strikingly low net reactivity of such clusters as 39 and 45 provides evidence that they have effectively crystallized into a single specially stable form. GRA

N91-12777# Colorado State Univ., Fort Collins. Dept. of Chemistry.
NEW ELECTRORELEASE SYSTEMS BASED ON MICROPOROUS MEMBRANES
Michael J. Tierney and Charles R. Martin 2 Aug. 1990 28 p
Prepared in cooperation with Teknekron Sensor Development Corporation, Menlo Park, CA Submitted for publication
(Contract N00014-82-K-0612; NR Proj. 627838)
(AD-A225315; TR-49-ONR) Avail: NTIS HC/MF A03 CSCL 07/4

Electrorelease systems have previously been based on electrochemical release of molecules chemically entrapped in polymer membranes. A new type of electrorelease system is described; this system is based on a microporous Al2O3 membrane covered with a barrier layer which seals the pores. Electrorelease occurs upon electrochemical dissolution or disruption of the barrier layer, which opens the pores. Two different barrier layers are investigated: silver and Na(+)-form Nafion. The electrorelease rate can be controlled by partially removing the barrier layer or by dividing the barrier layer into several individually-addressable zones. This configuration may also be used as a multi-dose device. GRA

N91-12778# Pittsburgh Univ., PA. Surface Science Center.
H-INDUCED SURFACE RESTRUCTURING ON Si(100): FORMATION OF HIGHER HYDRIDES
C. C. Cheng and J. T. Yates, Jr. 10 Aug. 1990 21 p
(Contract N00014-82-K-0280)
(AD-A225499; TR-35) Avail: NTIS HC/MF A03 CSCL 07/2

H-induced surface structures on Si(100) were studied using temperature programmed desorption (TPD) mass spectroscopy and low energy electron diffraction (LEED). It is shown that the (3x1) phase consists of mainly monohydride and dihydride structures, while the (1x1) phase is composed of a mixture of mono-, di-, and trihydride surface species. The trihydride surface species is associated with the phase transition between the (3x1) and (1x1) surface phases, and liberates SiH4 and beta 3-H2 during thermal desorption, beginning at 200 K. For the fully-saturated Si(100) surface, a saturation surface coverage of 1.9 ML H has been established at a Si(100) adsorption temperature of 210 plus or minus 10 K. These results suggest that the 1.9 ML saturation coverage of H on Si(100) involves the presence of SiH3(a) species, which leads surface involving a uniform SiH2(a) overlayer. GRA

N91-12779# North Atlantic Treaty Organization, Brussels (Belgium).
PROCEEDINGS OF THE NATO-ADVANCED STUDY INSTITUTE, DIAMOND AND DIAMOND-LIKE FILMS AND COATINGS
3 Aug. 1990 129 p Proceedings held in Castelvecchio Pasceli,

Italy, 22 Jul. - 3 Aug. 1990
(AD-A225517; R/D-6375-MS-02) Avail: NTIS HC/MF A07 CSCL 07/4

The primary objectives of an Advanced Study Institute (ASI) are to contribute to the dissemination of advanced knowledge not yet available in standard university courses and the formation of contacts among scientists from different countries. An Advanced Study Institute is a high level activity at which a carefully defined subject is presented in a systematic and coherently structured program. The subject is treated in considerable depth by lecturers eminent in their fields and of international standing. The presentations are made to students who are scientists already specialized in the field or possessing an advanced general scientific background. The lectures provide the basis for seminar discussions and the presentation and examination of recent research findings. The presentation of the latest research results of the participants should, however, not dominate an ASI. The goal of this NATO-Advanced Study Institute is to bring together scientists and engineers from various disciplines to discuss and clarify our current understanding of (1) the growth of diamond and diamond-like films, (2) the characterization of these materials, (3) the optical, physical and mechanical properties of these films, (4) the relationship of these properties to structure and processing, and (5) to indicate the current and potential technological applications of these new diamond and diamond-like materials. GRA

N91-12780# Maine Univ., Orono. Lab. for Surface Science and Technology.
A MODEL FOR SOLVENTLESS PMDA/ODA POLYAMIC ACID: CONSEQUENCES FOR THE REACTIVITY OF POLYAMIC ACID WITH METALS Technical Report, 1 Oct. 1989 - 30 Sep. 1990
T. Strunskus, M. Grunze, and S. Gnanarajan (Jaffna Univ. Therunelvely, Sri Lanka) 15 Aug. 1990 36 p Submitted for publication
(Contract N00014-89-J-1314)
(AD-A225818) Avail: NTIS HC/MF A03 CSCL 11/9

The core level spectra is discussed of solventless prepared poly(N,N'-p,p'-oxydiphenylene) pyromellitamic acid) or PMDA/ODA polyamic acid (PAA) films with particular emphasis on the chemical composition and on the 01s and C1s shake up transitions. Both vapor deposited polyamic acid and the resulting polyimide films show an excess of oxydianiline (ODA) and a deficiency of carbonyl groups. A qualitative analysis of the shake up transitions on the 01s and C1s core holes indicate that polyamic acid is in a non-planar conformation. A shoulder in the N1s band at higher binding energy was assigned to positively charged nitrogen and it was concluded that a proton is transferred from the amic acid group onto the nitrogen and we concluded that a proton is transferred from the amic acid group onto the nitrogen atom of unreacted oxydianiline. The amic group of the molecule is the primary site of interaction with evaporated gold atoms and with bulk silver surfaces. In the case of polyamic acid and polyimide films on polycrystalline silver the interfacial bonding is achieved via silver carboxylate linkages. GRA

N91-12781# Maine Univ., Orono. Lab. for Surface Science and Technology.
INTERACTION OF COPPER WITH A VAPOR DEPOSITED POLYIMIDE FILM Technical Report, 1 Oct. 1989 - 30 Sep. 1990
R. G. Mack, E. Grossman, and W. N. Unertl 15 Aug. 1990 19 p Submitted for publication Sponsored in part by IBM, Endicott, NY
(Contract N00014-89-J-1314)
(AD-A225819) Avail: NTIS HC/MF A03 CSCL 11/7

The interaction of copper with a vapor deposited film of PMDA-ODA polyimide was studied using x ray photoelectron spectroscopy (XPS) and scanning tunnelling microscopy (STM). Copper was evaporated onto the polyimide surface to total thickness estimated to be about five atomic layers. The copper initially interacts with the planar imide ring - the nitrogen XPS signal is preferentially attenuated, some copper is oxidized, and the carbonyl XPS intensities are altered. No evidence was found for chemical interaction with the ODA part of the polyimide. Heating the copper covered surface leads to redistribution of copper, probably below the surface as reported in earlier studies. STM images of the heated surfaces show that substantial surface roughening has occurred. GRA

N91-12782# Chemical Research and Development Center, Aberdeen Proving Ground, MD.
SAMPLING AND ANALYSIS OF ORGANOPHOSPHORUS COMPOUNDS ON A THERMOELECTRIC COLD PLATE USING FOURIER TRANSFORM INFRARED EMISSION SPECTROSCOPY Final Report, Apr. 1986 - Dec. 1987
M. R. Whitbeck, Hugh R. Carlon, and Craig R. Allan Jul. 1990 41 p Prepared in cooperation with Nevada Univ., Reno
(AD-A225964; CRDEC-TR-183) Avail: NTIS HC/MF A03 CSCL 07/2

This research addressed the sampling of organophosphorus compounds from the air and their detection using Fourier transform infrared (FTIR) techniques with computer-aided pattern recognition. Vapor samples from a thermoelectrically-cooled plate, typically used as a liquid aerosol collector, were examined to determine the feasibility of recording infrared emission spectra directly from the plate. A comparison of this method was made with gas chromatography/infrared (GC/IR) spectroscopy analysis of samples that were first removed from the plate. GRA

N91-12783# Ballistic Research Labs., Aberdeen Proving Ground, MD.
LASER-BASED MULTIPHOTON EXCITATION PROCESSES IN COMBUSTION DIAGNOSTICS Final Report, Oct. 1988 - Oct. 1989
Brad E. Forch, Andrzej W. Miziolek, and Jeffrey B. Morris Jul. 1990 35 p
(AD-A226031; BRL-TR-3125) Avail: NTIS HC/MF A03 CSCL 21/2

Light atomic species such as oxygen atoms (O) and hydrogen atoms (H) are fundamentally important in a wide variety of combustion related phenomena such as flame ignition, propagation, extinction, and in chemical flame reactions. Furthermore, they are difficult to detect by conventional laser based optical methods (laser induced fluorescence) in combustion environments because the necessary resonance excitation wavelengths fall far into the vacuum ultraviolet (vuv) and the requisite tunable laser sources are not generally available. However, recent developments in nonlinear spectroscopic techniques such as multiphoton induced emission (MPE) and multiphoton ionization (MPI) have made direct detection of these light atoms possible. We have utilized a number of laser multiphoton excitation schemes for their detection using tunable lasers in the 190 to 400 nm range. Similar diagnostic techniques were attempted for the detection of carbon (C) and nitrogen (N) atoms in flames. The effects of laser induced photochemical perturbations on species detection in flames were also investigated. GRA

N91-12784# Dexter Corp., Pittsburgh, CA. Hysol Aerospace.
AT-RESIN RESEARCH: BIOTECHNICAL SUPPORT AND HETEROGENEOUS CATALYSIS Final Technical Report, 1 Sep. 1989 - 15 Jul. 1990
Yesh P. Sachdeva 20 Jul. 1990 39 p
(Contract F49620-89-C-0042)
(AD-A226076; AFOSR-90-0864TR) Avail: NTIS HC/MF A03 CSCL 07/4

Four additional batches of polyethylene (PE)-supported palladium catalyst were prepared. These catalysts have been evaluated for the preparation of a diynol addition product 2 starting from 4,4-bis(3-bromophenoxy) diphenyl sulfone 1. Palladium still leaches into the product. The reaction conditions of palladium complexation with triphenyl phosphine (TPP) were studied. The optimum amount of TPP required in the diynol addition reaction was lowered to a range of one-half as compared to the established procedures. Under the Biotech-Support part of this program, reaction conditions favoring condensation of phenols and aromatic halides were explored using model reactions of m-cresol and

dichlorodiphenyl sulfone and difluorobenzophenone. Condensation reactions were faster in the presence of 18-Crown-6 than CsI. Difluorobenzophenone reacted faster than dischlordiphenyl sulfone with m-cresol. The reaction conditions were applied to the condensation of m-hydroxphenyl acetylene and aromatic dihadlides. GRA

N91-12785# Brookhaven National Lab., Upton, NY.
ASSESSMENT OF THE APPLICABILITY OF RAMAN SPECTROSCOPY TO THE DETECTION OF CHEMICAL AGENTS
Robert E. Barletta Jul. 1990 13 p
(Contract DE-AC02-76CH-00016)
(DE90-017198; BNL-44846) Avail: NTIS HC/MF A03

The use of Raman spectroscopy for the detection of chemical agents, precursors and by-product chemicals relevant to the verification of chemical weapons treaties has been evaluated. Four types of Raman-based systems have been considered: remote surveillance, field analysis (including in-plant monitoring) and microprobe analysis. The practicality of the development of such systems is dependent upon the magnitude of the Raman cross section. Since this increases with the fourth power of the frequency, the use of UV radiation is of great benefit. Further, based upon literature data, it appears that a large enhancement of the cross section for several agents can be expected in the UV due to near-resonance effects. It was concluded that Raman-based systems using UV radiation could be developed with sensitivities in the range of 100 ppM or less. DOE

N91-12786# United Technologies Research Center, East Hartford, CT.
INVESTIGATION OF PARTICULATE FORMATION DURING DIESEL SPRAY COMBUSTION Technical Progress Quarterly Report, 1 Jun. - 31 Aug. 1990
1990 6 p
(Contract DE-AC04-87AL-43058)
(DE90-017871; DOE/AL-43058/T4) Avail: NTIS HC/MF A02

The objective of the contract is to conduct an experimental and analytical research program to investigate strategies for using coherent anti-Stokes Raman scattering (CARS) laser diagnostic techniques for detecting the degree of fuel pyrolysis and determining fuel-air ratio. Smoke and NO(sub x) production rates depend in a complex way on the local temperature, the evaporation of the diesel spray, the local fuel-air ratio, and the pyrolysis history of the fuel. Furthering the ability of CARS to provide more of this information may give engine designers more insight into the combustion process and allow them to create engines which produce fewer particulates or lower amounts of NO(sub x). Controlling the production rates is preferable to processing emissions. If they cannot both be suppressed simultaneously, adjusting the tradeoff between producing particulates or NO(sub x) may be helpful if an exhaust processing method is available for one of them. DOE

N91-12787# Purdue Univ., West Lafayette, IN. Flame Diagnostics Lab.
QUENCHING-INDEPENDENT MEASUREMENT OF SPECIES CONCENTRATIONS IN FLAMES BY LASER-INDUCED FLUORESCENCE Final Report, 1 Jan. 1988 - 31 Dec. 1989
J. Thaddeus Salmon, Campbell D. Carter, and Normand M. Laurendeau Sep. 1990 29 p
(Contract DE-FG02-88ER-13866)
(DE91-000795; DOE/ER-13866/1) Avail: NTIS HC/MF A03

This report describes work accomplished in the last two years on measurement of species concentrations in flames via laser-induced fluorescence. During this period, we have published absolute number densities of atomic hydrogen in subatmospheric, premixed C2H4/O2/Ar flames at equivalence ratios of 1.0 and 1.7 via two-photon excited fluorescence. This work has led to the development of a new single-laser, two-step fluorescence method for the detection of atomic hydrogen in flames. Using Photolonization Controlled-Loss Spectroscopy (PICLS), we have verified the T(exp -1/2) dependence of quenching on temperature for atomic hydrogen, in agreement with kinetic theory. Previous work on pyrometry using Laser-Saturated Fluorescence (LSF) and the anomalous fluorescence from pyrene has evolved into publication of a major review paper on temperature measurements by light-scattering methods. Finally, we have demonstrated the feasibility of quantitative LSF measurements of NO concentration by obtaining relative saturation curves and NO fluorescence profiles. DOE

N91-12788# Pittsburgh Univ., PA.
THE PHYSICS OF PATTERN FORMATION AT LIQUID INTERFACES
1990 19 p
(Contract DE-FG02-84ER-45131)
(DE91-000856; DOE/ER-45131/8) Avail: NTIS HC/MF A03

This paper discusses pattern formation at liquid interfaces and interfaces within disordered materials. The particular topics discussed are: a racetrack for competing viscous fingers; an experimental realization of periodic boundary conditions; what sets the length scale for patterns between miscible liquids; the fractal dimension of radial Hele-Shaw patterns; detailed analyses of low-contrast Saffman-Taylor flows; and the wetting/absorption properties of polystyrene spheres in binary liquid mixtures. DOE

N91-12789# Oak Ridge National Lab., TN.
RESONANCE IONIZATION SPECTROSCOPY AND ITS APPLICATIONS Foreign Trip Report
J. M. Ramsey 11 Oct. 1990 6 p
(Contract DE-AC05-84OR-21400)
(DE91-001150; ORNL/FTR-3773) Avail: NTIS HC/MF A02

The Fifth International Symposium in Resonance Ionization Spectroscopy and Its Applications was attended. The Joint Research Centre of the European Communities at Ispra, Italy was also visited. The traveller presented an invited talk, chaired a meeting session and gave an impromptu presentation on how current laser technology limits the development of commercial instrumentation based upon Resonance Ionization Spectroscopy. The conference was truely international with scientists from 19 countries and less than 1/4 from the U.S. The meeting also provided a health mixture of experimentalists and theoreticians. Technical developments reported included the use of electric field ionization from laser prepared Rydberg states as a way to reduce background signals and commercial development of an optical parametric oscillator for replacing pulsed dye laser. A speaker from the Soviet Union suggested their willingness to market hardware they have developed based upon the resonance ionization technique. DOE

N91-12790# Sandia National Labs., Albuquerque, NM.
DETONATION CELL WIDTHS IN HYDROGEN-AIR-DILUENT MIXTURES
Douglas W. Stamps 1990 18 p Presented at the 1990 Combustion Institute Fall Meeting, San Diego, CA, 14-16 Oct. 1990
(Contract DE-AC04-76DP-00789)
(DE91-000771; SAND-90-2251C; CONF-9010207-1) Avail: NTIS HC/MF A03

Influence of steam and carbon dioxide on the detonability of hydrogen-air mixtures are reported. Data were obtained on the detonation cell width in a heated detonation tube that is 0.43 m in diameter and 13.1 m long. The detonation cell widths were correlated using a characteristic length calculated from a chemical kinetic model. The addition of either diluent to a hydrogen-air mixture increased the cell width for all equivalence ratios. For equal diluent concentrations, however, carbon dioxide not only yielded larger increases in the cell width than steam, but its efficacy relative to steam was predicted to increase with increasing concentration. The range of detonable hydrogen concentrations in a hydrogen-air mixture initially at 1 atm pressure was found to be between 11.6 percent and 74.9 percent for mixtures at 20 C and 9.4 percent and 76.9 percent for mixtures at 100 C. The detonation limit was between 38.8 percent and 40.5 percent steam

for a stoichiometric hydrogen-air-steam mixture initially at 100 C and 1 atm. DOE

N91-12791# State Univ. of New York, Buffalo. Dept. of Chemistry.
SEMIEMPIRICAL STUDY OF RARE GAS AND RARE GAS-HYDROGEN IONIC CLUSTERS: Rn(+), (RnH)(+) AND (RnH2)(+) FOR R = Ar, Xe
Isidore Last (Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.) and Thomas F. George Aug. 1990 56 p Submitted for publication
(Contract N00014-90-J-1193)
(AD-A226464; UBUFFALO/DC/90/TR-22) Avail: NTIS HC/MF A04 CSCL 07/2

The ionic rare gas clusters Argon and Xenon and rare gas-hydrogen clusters are studied by the semiempirical diatomics-in-ionic-systems (DIIS) method. The Argon clusters are seen to have a structure of a linear core surrounded by n-3 neutral or almost neutral Argon atoms. For Xenon, a symmetrical Xenon ionic core with the geometry of regular pyramid is formed. The rare gas-hydrogen clusters with one H atom have a simple structure with K neutral rare gas atoms attracted to the (RH)+ molecule by polarization forces. GRA

N91-12792# Stanford Univ., CA. Dept. of Chemistry.
FTIR STUDIES OF H2O AND D2O DECOMPOSITION ON POROUS SILICON SURFACES Interim Report
P. Gupta, A. C. Dillon, A. S. Bracker, and S. M. George 31 Jul. 1990 33 p Submitted for publication Sponsored in part by NSF and A. P. Sloan Foundation
(Contract N00014-86-K-0545)
(AD-A226581; SU-TR-12) Avail: NTIS HC/MF A03 CSCL 07/4

The decomposition of H2O and D2O on silicon surfaces was studied using transmission Fourier-Transform Infrared (FTIR) spectroscopy. These FTIR studies were performed in-situ in an ultra-high vacuum chamber using high chamber area porous silicon samples. The FTIR spectra revealed that H2O (D02) initially dissociates upon adsorption at 300 K to form SiH (SiD) and SiOH (SiOD) surface species. The decomposition of these surface species was then monitored. As the silicon surface was annealed to 650 K, the FTIR spectra revealed that the SiOH surface species progressively decomposed to Si-O-Si species and additional SiH species. Above 650 K, the SiH surface species decreased concurrently with the desorption of H2 from the porous silicon surface. GRA

N91-12793# Stanford Univ., CA. Dept. of Chemistry.
FTIR STUDIES REVEAL THAT SILICON-CONTAINING LASER-INDUCED DESORPTION PRODUCTS ARE SURFACE REACTION INTERMEDIATES Interim Report
P. Gupta, A. C. Dillon, P. A. Coon, and S. M. George 31 Jul. 1990 21 p Submitted for publication Sponsored in part by NSF and A. P. Sloan Foundation
(Contract N00014-86-K-0545)
(AD-A226582; SU-TR-11) Avail: NTIS HC/MF A03 CSCL 20/5

Silicon containing laser induced desorption (LID) products such as SiOH and SiNH2 have been observed from Si(111)7x7 surfaces exposed to H2O and NH3. Assuming that the LID species were derived from surface reaction intermediates, these LID products were employed to examine the thermal stability of the SiOH and SiNH2 surface species. Fourier transform infrared (FTIR) transmission spectroscopy was recently utilized to monitor the decomposition of SiOH and SiNH2 surface species following the dissociative adsorption of H2O and NH3 on porous silicon surfaces. The FTIR results on porous silicon surfaces were in excellent agreement with the previous LID studies on Si(111)7x7. The correspondence between the FTIR and LID investigations indicated that silicon-containing LID products are derived from silicon surface reaction intermediates. GRA

N91-12794# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
HIGH RESOLUTION REFLECTION SPECTROSCOPY AT THE THREE DIMENSIONAL STATES OF THE Zn IONS IN Zn(1-x)Mn(x)S AND Zn(1-x)Mn(x)Te Ph.D. Thesis [HOCHAUFLOESENDE REFLEXIONSSPEKTROSKOPIE AN DEN 3D-ZUSTAENDEN DER ZN-IONEN IN ZN1-XMNXS UND ZN1-XMNXTE]
Christian Jung 1990 149 p In GERMAN
(ETN-90-98180) Avail: NTIS HC/MF A07

Examinations of the absolute reflection power at the 3-D states of the Zn ions in two alloys are presented. A measurement apparatus was built which allows temperature measurements in the spectral area of the visible light and the vacuum ultraviolet radiation with a two ray reflectometer. The dielectric function was calculated by means of the Kramers-Kronig relations. The measured reflection power in low energy area was extrapolated with an exponential function. It is shown that the d-electrons of the cations in ZnS and ZnTe are influenced by the crystal field interaction and the interaction between the p-states of the anions and the cations 3-D states. In the case of ZnMnTe the bond energy of the Zn 3-D states drops with increasing Mn concentration. ESA

N91-12524# Fukui Univ. (Japan). Dept. of Mechanical Engineering.
NUMERICAL SIMULATION OF HIGH-SPEED COMBUSTION INDUCED BY OBLIQUE SHOCK WAVE
Shiro Taki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 71-75 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12594# Tokyo Metropolitan Univ. (Japan). Coll. of Aeronautical Engineering.
NUMERICAL SIMULATION OF HYDROGEN-OXYGEN CHEMICAL REACTIONS IN ANNULAR COMBUSTION CHAMBER
Shizui Watanabe and Shuuji Fujii *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 15-19 In JAPANESE (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N91-12795*# Clarkson Univ., Potsdam, NY. School of Engineering.
INFLUENCE OF CONVECTION ON MICROSTRUCTURE Semiannual Progress Report No. 4, 15 Feb. - 14 Aug. 1990
William R. Wilcox, Rubens Caram, A. P. Mohanty, and Jayshree Seth Sep. 1990 81 p
(Grant NAG8-753)
(NASA-CR-186996; NAS 1.26:186996) Avail: NTIS HC/MF A05 CSCL 11F

In eutectic growth, as the solid phases grow they reject atoms to the liquid. This results in a variation of melt composition along the solid/liquid interface. In the past, mass transfer in eutectic solidification, in the absence of convection, was considered to be governed only by the diffusion induced by compositional gradients. However, mass transfer can also be generated by a temperature gradient. This is called thermotransport, thermomigration, thermal diffusion or the Soret effect. A theoretical model of the influence of the Soret effect on the growth of eutectic alloys is presented. A differential equation describing the compositional field near the interface during unidirectional solidification of a binary eutectic alloy was formulated by including the contributions of both compositional and thermal gradients in the liquid. A steady-state solution of the differential equation was obtained by applying appropriate boundary

conditions and accounting for heat flow in the melt. Following that, the average interfacial composition was converted to a variation of undercooling at the interface, and consequently to microstructural parameters. The results obtained show that thermotransport can, under certain circumstances, be a parameter of paramount importance. Author

N91-12796 Brunel Univ., Uxbridge (England).
HYDROGEN IN ALUMINIUM AND ITS ALLOYS Ph.D. Thesis
D. E. J. Talbot 1989 355 p
Avail: Univ. Microfilms Order No. BRDX90224

The whole range of interactions between hydrogen and aluminum and its alloys are explored. The state of hydrogen occluded in the metal is examined. The treatment uses the embedded atom theory to clarify solute trapping concepts and gives an original mathematical treatment identifying characteristics of the solvent metal. The continuing developments of the vacuum sub-fusion and the Telegas microcarrier gas techniques are discussed. New determinations for the solubility and diffusivity of hydrogen in liquid pure aluminum and in several liquid and solid aluminum-lithium alloys are also discussed. Sievert's isotherm and Vant Hoff's isobar show that the gas always dissolves endothermically as atoms and solubility differences between liquid aluminum and aluminum-lithium alloys are due to differences in solution entropy. Solid aluminum-lithium alloys exhibit discontinuities in the isobar as the temperature falls below critical values (an effect attributed to changes in the internal structure of the metallic alpha phase). The formation, distribution, and behavior of interdendritic and secondary porosity were characterized quantitatively and their effects assessed. Extensive experiments have identified the primary sources of hydrogen in both liquid and solid metal during manufacture as interaction of the metal with atmospheric water vapor through the kinetics of surface oxidation and subcutaneous inclusions impressed by rolling. Experiments show that liquid metal degassing in furnaces is unreliable and that in-line degassing is successful, only when it is an aspect of a comprehensive liquid metal treatment which also removes inclusions. Effective methods are recommended for restricting the entry of hydrogen into the metal, removing it when present, and arranging production procedures to minimize its deleterious effects. Dissert. Abstr.

N91-12797# Martin Marietta Corp., Denver, CO. Astronautics Group.
FABRICATION OF INTERMETALLIC COMPOUNDS BY SOLID STATE REACTION OF ROLL-BONDED MATERIALS Quarterly Progress Report No. 16, 10 May - 9 Aug. 1990
William C. Moshier 9 Aug. 1990 8 p
(Contract N00014-85-C-0857)
(AD-A225862; MCR-85-721) Avail: NTIS HC/MF A02 CSCL 11/6

Objectives of Present Research: Intermetallic compounds offer very high specific material properties and property retention at elevated temperatures. However, reliable processing techniques to fabricate these materials have not been developed. This program will investigate the use of a novel, low cost fabrication technique involving a deformation-solid state reaction bonding process to form titanium beryllides. The objectives of this investigation are to: Establish reaction kinetics for the formation of Ti beryllide intermetallic compounds, Establish processing parameters needed to reproducibly fabricate these materials, Characterize the properties of Ti beryllides fabricated using a deformation-solid state reaction bonding process, Investigate the effects of alloying additions on the crystal structure of Ti beryllides and determine how these changes impact mechanical properties. GRA

N91-12798# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Metallurgical Engineering and Materials Science.
AN INVESTIGATION OF THE ROLE OF SECOND PHASE PARTICLES IN THE DESIGN OF ULTRA HIGH STRENGTH STEELS OF IMPROVED TOUGHNESS Final Report, 7 Jul. 1986 - 1 Jun. 1990
W. M. Garrison, Jr. 20 Jun. 1990 54 p
(Contract DAAL03-86-K-0124)
(AD-A226056; CMU-1-50129; ARO-23261.10-MS) Avail: NTIS HC/MF A04 CSCL 11/6

In this report summarized work carried out as part of a research program designed to improve the upper shelf fracture toughness of ultra high strength steels and to gain further understanding of the processes associated with the fracture of these materials and how these processes are related to microstructure. The results emphasized are: (1) blunting behavior and its effects on toughness, (2) the effects of inclusion spacing at constant inclusion volume fraction on toughness, (3) observations on the effects of carbides and nitrides on toughness, (4) grain size effects and (5) studies of void nucleation at inclusions and the effects on toughness of gettering sulfur as particles rich in Ti, C, and S rather than as manganese sulfide. Our blunting studies indicate that blunting to vertices, although it is associated with low work hardening, appears to result in higher levels of toughness than smooth blunting. The results show that increasing inclusion spacing at constant inclusion volume fraction results in improvements in toughness until the inclusion spacing approaches some critical value; once the inclusion spacing exceeds that value the toughness is independent of particle spacing. GRA

N91-12799# Virginia Univ., Charlottesville. Dept. of Materials Science.
THE EFFECT OF ALLOY COMPOSITION AND PROCESSING ON THE STRUCTURE AND PROPERTIES OF I/M Al-Li-X ALLOYS Final Report, 1 Jul. 1986 - 31 Mar. 1990
E. A. Starke, Jr. and G. J. Shiflet Jul. 1990 20 p
(Contract DAAL03-86-K-0128)
(AD-A226202; UVA/525140/MS91/101; ARO-23940.8-MS)
Avail: NTIS HC/MF A03 CSCL 11/6

The major objectives of this program were to characterize the microstructure, deformation and fracture modes of Al-Li-X alloys with emphasis on determining the relationships between alloying elements, processing parameters, microstructure, and deformation and fracture behavior. We have found that the growth mechanism of T1 precipitate plates occurs by the diffusional glide of Shockley partials on (111) matrix planes and that the growth ledges migrate by the ledge-kink mechanism. Plastic deformation prior to aging was shown to decrease the T1 plate length and thickness, increase the number density by almost two orders of magnitude, increase the yield strength by 100 MPa while simultaneously reaching peak strength in 20 percent of the time required without plastic deformation. GRA

N91-12800# Ballistic Research Labs., Aberdeen Proving Ground, MD.
EXPLOSIVE CONSOLIDATION OF COMBUSTION SYNTHESIZED TiB2 AND TiC: MICROSTRUCTURAL PROPERTIES Final Report, 1 Oct. 1987 - 1 Oct. 1989
L. J. Kecskes, T. Kottke, P. H. Netherwood, Jr., R. F. Benck, and A. Niler Aug. 1990 43 p
(AD-A226390; BRL-TR-3133) Avail: NTIS HC/MF A03 CSCL 11/6

Near full density TiB2, TiC, and TiC-TiB2 composites have been fabricated by combustion synthesis reactions followed by dynamic consolidation of the still hot, porous, ceramic body. The relationship between the morphologies and purity of the precursor powders used and the ceramic product structures is presented. Intergrain bonding and residual porosity of the dynamically consolidated products are found to depend strongly on the impurity levels of the percursor powders. Analysis of the TiC indicates that the density and microhardness increase as a function of the C/Ti ratio with maximum values at the ratio of 1.0. GRA

N91-12801# Naval Postgraduate School, Monterey, CA.
NONMETALLIC INCLUSIONS IN HSLA STEEL WELDMENTS M.S. Thesis
Brent A. Douglas Dec. 1989 102 p
(AD-A226399) Avail: NTIS HC/MF A06 CSCL 11/6

The U.S. Navy is currently funding a program for certification of HSLA steels to replace the HY series of high strength steels

for structural fabrication. Integral to this program is the certification of welding consumables for use with these steels. The size, distribution and composition of nonmetallic inclusions in HSLA steel weld metal has been shown to play a key role in the final strength and toughness of the deposited weld. The purpose of this study was to develop a procedure for analysis of nonmetallic inclusions in HSLA steel multipass weldments utilizing optical microscopy and examination and energy despersive x ray spectroscope (EDX) analysis in a scanning electron microscope (SEM). The results of the study suggest that the mean diameter of inclusions in the final pass of a gas metal arc welding (GMAW) weldment in a 2.0 inch HSLA-100 plate is larger than the mean diameter of those in the root pass. Additionally the material in the final pass contains a greater amount of Si and Ti deoxidation products than that in the root pass. The larger size, composition and complex structure of the inclusions in the final pass suggest that they contain deoxidation products from previous welding passes which have been released through remelting and coalesced into larger inclusions. GRA

N91-12802# Oak Ridge National Lab., TN. Metals and Ceramics Div.

FABRICATION AND MECHANICAL PROPERTIES OF Fe3Al-BASED IRON ALUMINIDES

V. K. Sikka, C. G. McKamey, C. R. Howell, and R. H. Baldwin Mar. 1990 69 p

(Contract DE-AC05-84OR-21400)

(DE91-001001; ORNL/TM-11465) Avail: NTIS HC/MF A04

Iron aluminides based on Fe3Al are ordered intermetallic alloys that offer good oxidation resistance, excellent sulfidation resistance, and lower material cost than many stainless steels. These materials also conserve strategic elements such as chromium and have a lower density than stainless steels. However, limited ductility at ambient temperature and a sharp drop in strength have been major deterrents to their acceptance for structural applications. This report presents results on iron aluminides with room-temperature elongations of 15 to 20 percent. Ductility values were improved by a combination of thermomechanical processing and heat-treatment control. This method of ductility improvement has been demonstrated for a range of compositions. Melting, casting, and processing of 7 kg (15 lb) heats produced at the Oak Ridge National Laboratory (ORNL) and 70 kg (150 lb) commercial heats are described. Vacuum melting and other refining processes such as electroslag remelting are recommended for commercial heats. The Fe3Al-based iron aluminides are hot workable by forging or extruding at temperatures in the range of 850 to 1100 C rolling at 800 C is recommended with a final 50 percent reduction at 650 C. Tensile and creep properties of 7 and 70 kg (15 and 150 lb) heats are presented. The presence of impurities such as manganese an silicon played an important role in reducing the ductility of commercially melted heats. DOE

N91-12803# Minnesota Univ., Minneapolis. Corrosion Research Center.

A STUDY OF SCALE CRACKING AND ITS EFFECTS ON OXIDATION AND HOT CORROSION Final Report, 1 Nov. 1987 - 31 Oct. 1990

David A. Shores, James H. Stout, and William W. Gerberich May 1990 25 p

(Contract DE-FG02-88ER-45337)

(DE91-001327; DOE/ER-45337/1) Avail: NTIS HC/MF A03

For many high temperature applications, oxidation (or hot corrosion) is an important mode of degradation of metals and alloys. Degradation mechanisms may be divided into two categories: one dealing with the chemical and transport aspects of scale growth or dissolution, and the other dealing with mechanical aspects such as stresses and scale fracture. Some applications, such as corrosion/erosion, combine both aspects in a complicated manner. Much research has been concerned with relationships between alloy composition and scale growth rates, attempting to identify alloy compositions and growth mechanisms that form compact, slow-growing scales, such as Cr2O3 or Al2O3. Nevertheless, in practice a very common mode of scale degradation is cracking and spalling, followed by re-oxidation. Efforts to understand scale stresses and ultimately scale fracture have been hampered by the simultaneous interaction of numerous variables in determining the state of stress. Thus complex issues are involved in both experimental measurements and theoretical models of stresses and fracture of oxide scales. In this study we have considered both chemical/transport issues (as applied to the oxidation and hot corrosion of SiC and Ni-Cr Alloys) and mechanical issues of oxidation, but the emphasis has been on mechanical issues. In the following sections we will briefly describe the highlights of each of several projects, and where appropriate, will attach preprints or reprints of papers that describe in more detail the results of a particular study. DOE

N91-12804# Lawrence Livermore National Lab., CA.

ORDER-DISORDER PHENOMENA IN COMPLEX ALLOYS: THE CASE OF A15-BASED SUBSTITUTIONAL ALLOYS

P. E. A. Turchi and A. Finel (Office National d'Etudes et de Recherches Aeronautiques, Paris, France) 15 Aug. 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990

(Contract W-7405-eng-48)

(DE91-000815; UCRL-102340; CONF-900466-90) Avail: NTIS HC/MF A02

We first discuss the applicability of the Generalized Perturbation Method to the study of ordering phenomena in complex alloys for which stability properties are electronically driven. In particular, according to previous work, it is recalled that a 3D-generalized Ising model is appropriate to address the problem of configurational order in A15-based substitutional alloys. A ground state analysis of this model, including 1st, 2nd, and weak 3rd and 7th pair interactions, generates two new ordered states at the composition A(sub 5)B(sub 3) and A(sub 7)B, apart from the well known A(sub 3)B configuration. The stability of these predicted configurations is examined as a function of temperature and concentration by means of standard statistical techniques. The results are discussed in relation with the experimental situation. DOE

N91-12805# Oak Ridge National Lab., TN.

PROCEEDINGS OF THE 4TH ANNUAL CONFERENCE ON FOSSIL ENERGY MATERIALS

R. R. Judkins, comp. and D. N. Braski, comp. Aug. 1990 514 p Conference held in Oak Ridge, TN, 15-17 May 1990

(Contract DE-AC05-84OR-21400)

(DE91-001158; ORNL/FMP-90/1; CONF-900546) Avail: NTIS HC/MF A21

The Fourth Annual Conference on Fossil Energy Materials was held in Oak Ridge, Tennessee, on May 15 to 17, 1990. The meeting was sponsored by the U.S. Department of Energy's Office of Fossil Energy through the Advanced Research and Technology Development (AR and TD) Materials Program, and ASM International. The objective of the AR and TD Materials Program is to conduct research and development on materials for longer-term fossil energy applications as well as for generic needs of various fossil fuel technologies. The work is divided into the following categories: (1) Ceramics, (2) New Alloys, (3) Corrosion and Erosion, and (4) Technology Assessment and Technology Transfer. Individual projects are processed separately for the data bases. DOE

N91-12806# Wright Research Development Center, Wright-Patterson AFB, OH. Materials Engineering Branch.

THE MECHANICAL PROPERTY DATA BASE FROM AN AIR FORCE/INDUSTRY COOPERATIVE TEST PROGRAM ON ADVANCED ALUMINUM ALLOYS Interim Report, Jul. 1986 - Jan. 1990

Mary Ann Phillips and Steven R. Thompson Jun. 1990 194 p (AF Proj. 2418)

(AD-A226410; WRDC-TR-90-4072) Avail: NTIS HC/MF A09 CSCL 11/4

Development of a mechanical property data base on Pechiney aluminum-lithium structural alloys is detailed. Aluminum-lithium alloys tested were 2091-T3 sheets, 2091-T8x sheets, 2091-T351

plates, 2091-T6 forgings, and 8090-T651 T-extrusion. Basic mechanical property data consists of tension, compression, bearing, shear, and fracture toughness. Fatigue data were developed for both smooth and notched specimens. Constant amplitude fatigue crack growth rate data and spectrum test data was performed on most products. Corrosion characteristics were also obtained. All other data developed by the participants are documented. GRA

N91-12807# Institut Franco-Allemand de Recherches, Saint-Louis (France).
TUBE EROSION FOR 20 mm CALIBER AT PRESSURE UP TO 5000 BAR: ANALYSIS OF THE MATERIALS AND THEIR WEAR [ROHRREROSION IM KALIBER 20 MM BEI DRUECKEN BIS 5000 BAR: VERSCHLEISS- UND WERKSTOFFUNTERSUCHUNG]
F. Seiler, K. Zimmermann, V. Schlett (Fraunhofer-Inst. fuer Angewandte Material Forschung, Bremen, Germany, F.R.), and G. Zettler 17 Jan. 1989 96 p In GERMAN
(ISL-R-104/89; ETN-90-98037) Avail: NTIS HC/MF A05

A metallographic analysis of the sample surface is realized with erosion probes to verify the effects of the titanium dioxide on the tube erosion. The examination of the samples shows that the fragilization by hydrogen is not involved in the erosion process. The Auger spectroscopy of the steel shows the thickness of the ablation and the oxided layers. It is assumed that the titanium dioxide does not reduce the erosion. ESA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N91-12808# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Ceramics.
MECHANICAL STRENGTH OF SILICA XEROGELS
Bennet Abramoff and Lisa C. Klein 20 Jun. 1990 16 p
(Contract N00014-87-K-0529)
(AD-A225020; TR-4) Avail: NTIS HC/MF A03 CSCL 07/6

Mechanical strengths have been measured for silica xerogels using 4- point bending. The silica xerogels studied are microporous with open porosity of 53 vol percent. Strengths were measured on fresh samples, samples which had been outgassed at 250 C, sample which were exposed to ambient conditions for 2 days, and sample stored in ethanol. Fresh samples had strengths about 20 MPa which increased to 32 MPa with outgassing but returned to 20 MPa after exposure. The loss of strength could be arrested but not reversed by storing the samples in ethanol. GRA

N91-12809# Lawrence Livermore National Lab., CA.
A HIGH TEMPERATURE, PLASMA-ASSISTED CHEMICAL VAPOR DEPOSITION SYSTEM
R. M. Brusasco, J. A. Britten, C. B. Thorsness, M. S. Scrivener, W. G. Unites, J. H. Campbell, and W. L. Johnson (Prototech, Inc., Chandler, AZ.) Feb. 1990 12 p Presented at the 1989 Boulder Damage Symposium, Boulder, CO, 1-3 Nov. 1989 Submitted for publication
(Contract W-7405-eng-48)
(DE91-000260; UCRL-101766; CONF-8911192-7) Avail: NTIS HC/MF A03

A high-temperature, plasma-assisted, chemical vapor deposition system was designed and built to deposit multilayer optical coatings of SiO2 and doped-SiO2 flat substrates. The coater concept and design is an outgrowth of the recent work with Schott Glasswerke demonstrating the use of plasma assisted CVD to prepare very high damage threshold optical coatings. The coater is designed to deposit up to several thousand alternating quarterwave layers of SiO2 and doped SiO2 substrate at deposition rates up to several microns per minute. The substrate is resistively heated to about 1000 C during the deposition phase of the process. The plasma is driven by a 13.56 MHz RF unit capable of producing power densities of up to 140 W cu cm in the reaction zone. The coater is designed to be adaptable to microwave generated plasmas, as well as RF. Reactant gas flow rates of up to 10 slm can be achieved at a 10 tar operating pressure. Reactants consist of O2, SiCl4, and a volatile halogenated dopant. These gases react in the plasma volume producing SiO2 with dopant concentrations of up to a few percent. A variable dopant concentration is used to produce index differences between adjacent optical layers. DOE

N91-12810# Missouri Univ., Kansas City.
THEORETICAL STUDIES ON THE ELECTRONIC STRUCTURE AND PROPERTIES OF COMPLEX CERAMIC CRYSTALS AND GLASSES Annual Progress Report, 1 Jul. 1989 - 30 Jun. 1990
Wai-Yim Ching 1 Jun. 1990 31 p
(Contract DE-FG02-84ER-45170)
(DE91-000595; DOE/ER-45170/6) Avail: NTIS HC/MF A03

This annual report covers the last year of a three-year project supported by the Department of Energy that was started on July 1, 1986. Within these three years, a phenomenal amount of research results have been obtained. In the following section, Section 2, the research work accomplished is summarized since July 1, 1986 as was documented in the renewal proposal. In Section 3, additional accomplishments since the submission of the renewal proposal are listed. Section 4 contains the figures that have been referred to in Section 2. In Section 5, the scientific personnel and students that have been involved in the project are listed. Technical papers published or submitted under the DOE support since the last annual report are documented in Section 5. Because of the large number of papers published or submitted, reprint and preprint copies will be submitted separately instead of attaching in the form of appendix. DOE

N91-12811# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
VISCOELASTICITY AND CREEP RECOVERY OF POLYIMIDE THIN FILMS
Fariborz Maseeh and Stephen D. Senturia Jun. 1990 15 p
(Contract MDA972-88-K-0008; NSF DMR-87-19217)
(AD-A225475; VLSI-Memo-90-600) Avail: NTIS HC/MF A03 CSCL 07/6

Creep and recovery of a polyimide thin film well below its glass transition temperature is demonstrated through use of circular membrane bulge test. Extensive use is made of a recently developed mechanical CAD system linked to the fabrication process to model the structure. A creep power law is used in a nonlinear finite element (FEM) analysis to fit the experimental results, thereby measuring the viscoelastic properties. GRA

N91-12812# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
PLASTIC DEFORMATION OF HIGHLY DOPED SILICON
Fariborz Maseeh and Stephen D. Senturia Oct. 1989 10 p
(Contract MDA972-88-K-0008; ARPA Order 6510)
(AD-A225476; VLSI-Memo-89-568) Avail: NTIS HC/MF A02 CSCL 07/2

Heavily boron doped membranes are shown to be under tensile intrinsic stress with a negative intrinsic bending moment. However, the use of an oxide etch mask during membrane fabrication can alter the state of stress to an apparent compressive state with a positive bending moment. We propose that plastic deformation of the p+ silicon beneath the compressively stressed oxide mask can account for this behavior. GRA

N91-12813# Maine Univ., Orono. Lab. for Surface Science and Technology.
PROPERTIES AND ADHESION OF POLYIMIDES IN MICROELECTRONIC DEVICES Technical Report, 1 Oct. 1989 - 30 Sep. 1990
M. Grunze (Heidelberg Univ., Germany, F.R.) 15 Aug. 1990 12 p Presented at the European Conference on Advanced Materials and Processes Submitted for publication Sponsored in part by IBM

(Contract N00014-89-J-1314)
(AD-A225728) Avail: NTIS HC/MF A03 CSCL 09/1

This paper gives a summary on the properties of polyimide films used in microelectronic devices and on recent research efforts to understand the adhesion between polyimides and inorganic materials. One of the major concerns in the application of polyimides is the integrity and reliability of the laminar structures. Surface sensitive spectroscopies have been recently applied to identify the nature of the chemical bond for metals evaporated onto cured polyimide surfaces and for spun-on and subsequently imidized polyamic acid films on metal surfaces. Depending on the preparation of the interface, e.g., metal on polymer or polymer on bulk metal, different phenomena are observed. GRA

N91-12814# Maine Univ., Orono. Lab. for Surface Science and Technology.
VAPOR DEPOSITION OF POLYIMIDE AND POLYIMIDE PRECURSORS ON COPPER Technical Report, 1 Oct. 1989 - 30 Sep. 1990
R. N. Lamb, M. Grunze (Heidelberg Univ., Germany, F.R.), J. Baxter, C. W. Kong, and W. N. Unertl 15 Aug. 1990 27 p Submitted for publication
(Contract N00014-89-J-1314; NSF DMR-84-03831)
(AD-A225729) Avail: NTIS HC/MF A03 CSCL 11/6

In this article we describe experiments in which ultra-thin films of polyimide were formed on polycrystalline and (111) single crystal copper substrates following heating of a vapor deposited layer of polyamic acid produced by codeposition of 4,4'-diaminodiphenyl ether (ODA) and 1,2,4,5- benzenetetracarboxylic dianhydride (PMDA). The adsorption of the pure components and their subsequent polymerization was followed, in situ, with x ray photoelectron spectroscopy. Molecular adsorption of the monomers was studied to determine their thermal stability. The composition and adhesion of the thin polyimide film is influenced by fragmentation of precursors at the interface. GRA

N91-12815# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemistry.
DESIGN AND SYNTHESIS OF CVD PRECURSORS TO THIN FILM CERAMIC MATERIALS
L. V. Interrante, B. Han, J. B. Hudson, and C. Whitmarsh Aug. 1990 12 p Submitted for publication Sponsored by Akzo Corp.
(Contract N00014-85-K-0632)
(AD-A225759) Avail: NTIS HC/MF A03 CSCL 11/2

The application of cyclic organometallic compounds as single source precursors for the chemical vapor deposition of materials such as AlN and SiC is discussed and new results relating to the decomposition of a novel SiC CVD precursor are presented. The decomposition of the cyclic carbosilane (CH2)2Si(CH3)(H)Si-(CH3)-(CH2SiH2CH3), on a heated glassy carbon substrate in an ultrahigh vacuum molecular beam system was studied by pulsing the precursor molecule onto the surface and following the mass spectrum as a function of the substrate surface temperature. The evolution of CH3SiH2,C2H5 and CH3 was evidenced, suggesting loss of excess carbon as C1 and C2 species. GRA

N91-12816# University of Southern California, Los Angeles. Dept. of Chemical Engineering.
MODEL FILLED POLYMERS. PART 6: DETERMINATION OF THE CROSSLINK DENSITY OF POLYMERIC BEADS BY SWELLING Technical Report No. 6, 1 Jul. 1989 - 1 Jul. 1990
Z. Y. Ding, J. J. Aklonis, and R. Salovey 22 Aug. 1990 13 p Submitted for publication
(Contract N00014-88-K-0302)
(AD-A225783) Avail: NTIS HC/MF A03 CSCL 07/6

A new method was developed to characterize the crosslink density of monodisperse polymeric microbeads by equilibrium swelling on an ultrafiltration membrane, followed by the removal of excess solvent by centrifugation. For polystyrene copolymerized with divinylbenzene and polymethyl methacrylate copolymerized with ethylene glycol dimethacrylate, the mole percent of crosslinked units, approximated, but always exceeded, the mole percent of divinyl monomer. Crosslink densities were varied from 1 to 11 percent. GRA

N91-12817# Massachusetts Inst. of Tech., Cambridge. Center for Materials Science and Engineering.
FUNDAMENTAL STUDIES OF NEAR SURFACE MODIFICATION OF CARBON FIBERS Final Report, 1 Sep. 1985 - 30 Apr. 1990
M. S. Dresselhaus and G. Dresselhaus 13 Jun. 1990 16 p
(Contract F49629-85-C-0147)
(AD-A225910; AFOSR-90-0859TR) Avail: NTIS HC/MF A03 CSCL 07/2

A summary of work carried out under the entire duration of this contract on Fundamental Studies of Near Surface Modification of Carbon Fibers from 9/1/85 to 4/30/90 is presented. GRA

N91-12818# Illinois Univ., Chicago. Dept. of Chemistry.
EVALUATION OF SOLID LUBRICANTS: THE CHEMISTRY OF SPUTTERED MoSx FILMS USING COMBINED THIN FILM ANALYSIS TECHNIQUES Final Report, May 1987 - Sep. 1990
Daniel E. Pierce, Richard P. Burns, Helen M. Dauplaise, and Lawrence J. Mizerka (Army Materials Technology Lab., Watertown, MA.) Aug. 1990 48 p Presented at the Society of Tribologists and Lubrication Engineers Annual Award Meeting, Boulder, CO, May 1990
(Contract DAAL03-87-K-0071; DA Proj. 1L1-61101-A-91-A)
(AD-A226134; MTL-TR-90-39) Avail: NTIS HC/MF A03 CSCL 11/8

Thermal Desorption Spectroscopy (TDS) is introduced as a diagnostic tool for determining the thermal stability of solid lubricant films. In particular, TDS revealed the temperatures at which various decomposition processes occurred as sputtered films were heated in vacuum. The primary film decomposition products detected were SO2 beginning at about 425 K and S2 beginning at about 1150 K. A close relationship between water desorption beginning about 400 K and SO2 desorption exists in the temperature range 400 to 800 K. Besides chemical decomposition products, a significant amount of argon trapped in the film during the sputtering process is released at various temperatures. TDS results for sputtered films were compared with results for burnished films and with Thermo-Gravimetric Analysis (TGA), water absorption, and other relevant studies of molybdenum disulfide found in the literature. GRA

N91-12819# Lowell Univ., MA. Dept. of Chemistry.
SYNTHESIS AND CHARACTERIZATION OF ELECTROACTIVE POLYMERS BASED ON PYRROLE
J. I. Chen, R. A. Moody, Jan-Chan Huang, and Sukant Tripathy Oct. 1989 14 p Presented at the Third Biennial Symposium on Electroresponsive Molecules and Polymer System, 25-27 Oct. 1989 Submitted for publication
(Contract N00014-90-J-1148)
(AD-A226324; TR-15) Avail: NTIS HC/MF A03 CSCL 07/6

A novel method for polymerizing pyrrole has been identified which utilizes aqueous KI3 solutions. This new synthesis technique enables a controlled method for incorporating pyrrole into composite systems to produce new electrically active polymers and to provide process control. Two electroactive systems were synthesized by this technique and characterized for their morphological and electrical properties. Electromembranes exhibited virtually no pore size restriction. Stable conductive coatings composed of ethylene-viny-lacetate (EVA) copolymer and polypyrrole (PPY) were also developed. GRA

N91-12820# Lowell Univ., MA. Dept. of Chemistry.
FAR INFRARED DIELECTRIC PROPERTIES OF POLYPYRROLE DOPED WITH THE TOSYLATE ANION
G. C. Phillips, R. Suresh, J. I. Chen, Jayant Kumar, and Jan-Chan Huang 1990 12 p
(Contract N00014-90-J-1148)
(AD-A226326; TR-12) Avail: NTIS HC/MF A03 CSCL 09/1

The dielectric constants and optical conductivities of films of

conducting polypyrrole with different doping levels were investigated. Measurements were carried out in the far infrared region (10 to 200 cm-1) and dielectric properties were determined by analysis of reflection and transmission intensities at normal incidence. The samples were prepared electrochemically, providing control of the doping level through reduction of the as grown (oxidized) film. Electrical conductivity measurements were performed with a four point probe. A method to determine the real and imaginary part of the complex index of refraction is described. The magnitudes and dispersive nature of the complex index refraction is described for a number of samples with different levels of conductivity. GRA

N91-12821# Lowell Univ., MA. Dept. of Chemistry.
COMPUTER SIMULATION OF SUBSTITUTED POLYACATYLENES
S. B. Clough, X. F. Sun, and S. Tipathy 1 Apr. 1990 5 p Presented at the Polymer Prefinals ACS Meeting, Boston, MA, 1 Apr. 1990
(Contract N00014-90-J-1148)
(AD-A226328; TR-20) Avail: NTIS HC/MF A01 CSCL 07/3

A wide variety of substituted polyacetylenes has been synthesized in recent years. Polyacetylene itself is a semiconductor with omega values as high as 10(-4) Scm(-1) for oriented films; when doped, polyacetylene is a conductor. The conjugated chain has a planar conformation. The substituted polymers are primarily insulators, however; the interaction of large substituted groups forces the chain in a non-planar conformation. Poly(1-(trimethylsilyl)-1-propyne), (PTMSP), has been found to be of particular interest, due to its large permeability to gases. The O2 permeability of PTMSP, for example, is an order of magnitude higher than that of polydimethyisiloxane. PTMSP is an amorphous polymer highly soluble in common organic solvents, and is oxidatively stable. Values of Mw higher than 10 (exp 6) have been achieved. Viscosity studies indicate PTMSP has an expanded structure. It is predicted that a given chain's twisted conformation will be maintained even in solution; the barriers for rotation about backbone bonds should prevent a change in conformation. GRA

N91-12822# Oak Ridge National Lab., TN. High Temperature Materials Lab.
COOPERATIVE INTERNATIONAL PROGRAM ON MECHANICAL STRENGTH MEASUREMENTS OF CERAMICS
V. J. Tennery and M. K. Ferber 1990 38 p Presented at the Annual Automotive Technology Development Contractor Coordination Meeting, Dearborn, MI, 22-25 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE91-000102; CONF-9010193-1) Avail: NTIS HC/MF A03

This report consists of viewgraphs for the presentation on the cooperative international program on mechanical strength measurements of ceramics for advanced heat engines. DOE

N91-12823# Oak Ridge National Lab., TN. Metals and Ceramics Div.
CERAMIC TECHNOLOGY FOR ADVANCED HEAT ENGINES PROJECT Semiannual Progress Report, Apr. - Sep. 1989
Aug. 1990 518 p
(Contract DE-AC05-84OR-21400)
(DE91-001004; ORNL/TM-11489) Avail: NTIS HC/MF A22

The Ceramic Technology For Advanced Heat Engines Project was developed by the Department of Energy's Office of Transportation Systems (OTS) in Conservation and Renewable Energy. This project, part of the OTS's Advanced Materials Development Program, was developed to meet the ceramic technology requirements of the OTS's automotive technology programs. Significant accomplishments in fabricating ceramic components for the Department of Energy (DOE), National Aeronautics and Space Administration (NASA), and Department of Defense (DOD) advanced heat engine programs have provided evidence that the operation of ceramic parts in high-temperature engine environments is feasible. However, these programs have also demonstrated that additional research is needed in materials and processing development, design methodology, and data base and life prediction before industry will have a sufficient technology base from which to produce reliable cost-effective ceramic engine components commercially. An assessment of needs was completed, and a five year project plan was developed with extensive input from private industry. The objective of the project is to develop the industrial technology base required for reliable ceramics for application in advanced automotive heat engines. The project approach includes determining the mechanisms controlling reliability, improving processes for fabricating existing ceramics, developing new materials with increased reliability, and testing these materials in simulated engine environments to confirm reliability. Although this is a generic materials project, the focus is on structural ceramics for advanced gas turbine and diesel engines, ceramic bearings and attachments, and ceramic coatings for thermal barrier and wear applications in these engines. DOE

N91-12824# Walcoff and Associates, Inc., Alexandria, VA.
POLYMER MATRIX COMPOSITES RESEARCH: A SURVEY OF FEDERALLY SPONSORED PROGRAMS
Jun. 1990 168 p
(Contract DE-AC01-89ER-30152)
(DE91-000453; DOE/ER-30152/H1T) Avail: NTIS HC/MF A08

This report identifies research conducted by agencies of the Federal government other than the Department of Energy (DOE) in the area of advanced polymer matrix composites (PMCs). DOE commissioned the report to avoid duplicating other agencies' efforts in planning its own research program for PMCs. PMC materials consist of high-strength, short or continuous fibers fused together by an organic matrix. Compared to traditional structural metals, PMCs provide greater strength and stiffness, reduced weight, and increased heat resistance. The key contributors to PMC research identified by the survey are the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Department of Transportation (DOT). The survey identified a total of 778 projects. More than half of the total projects identified emphasize materials research with a goal toward developing materials with improved performance. Although an almost equal number of identified materials projects focus on thermosets and thermoplastics, thermoplastics receive more attention because of their increased impact resistance, easy formability, and re-formability. Slightly more than one third of projects identified target structures research. Only 15 percent of the projects identified focus on manufacturing techniques, despite the need for efficient, economical methods of manufacturing products constructed of PMC's-- techniques required for PMC's to gain widespread acceptance. Three issues to be addressed concerning PMC's research are economy of use, improvements in processing, and education and training. Five target technologies have been identified that could benefit greatly from increased use of PMCs: aircraft fuselages, automobile frames, high-speed machinery, electronic packaging, and construction. DOE

N91-12825*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SPACECRAFT THERMAL BLANKET CLEANING: VACUUM BAKE OF GASEOUS FLOW PURGING
John J. Scialdone Washington Apr. 1990 25 p
(NASA-TM-100760; Rept-90B00065; NAS 1.15:100760) Avail: NTIS HC/MF A03 CSCL 11C

The mass losses and the outgassing rates per unit area of three thermal blankets consisting of various combinations of Mylar and Kapton, with interposed Dacron nets, were measured with a microbalance using two methods. The blankets at 25 deg C were either outgassed in vacuum for 20 hours, or were purged with a dry nitrogen flow of 3 cu. ft. per hour at 25 deg C for 20 hours. The two methods were compared for their effectiveness in cleaning the blankets for their use in space applications. The measurements were carried out using blanket strips and rolled-up blanket samples fitting the microbalance cylindrical plenum. Also, temperature scanning tests were carried out to indicate the optimum temperature for purging and vacuum cleaning. The data indicate that the purging for 20 hours with the above N2 flow can accomplish the same

level of cleaning provided by the vacuum with the blankets at 25 deg C for 20 hours, In both cases, the rate of outgassing after 20 hours is reduced by 3 orders of magnitude, and the weight losses are in the range of 10E-4 gr/sq cm. Equivalent mass loss time constants, regained mass in air as a function of time, and other parameters were obtained for those blankets. Author

N91-12826# Lowell Univ., MA. Dept. of Chemistry.
DESIGN SYNTHESIS AND CHARACTERIZATION OF NOVEL POLYDIACETYLENES USING NEW ANALYTICAL TECHNIQUE
Final Technical Report, Feb. 1987 - Oct. 1989
Sukant Tripathy Aug. 1990 14 p
(Contract N00014-87-K-0131)
(AD-A226416) Avail: NTIS HC/MF A03 CSCL 07/6

Significant progress was made in design, synthesis and analysis of a number of electroactive polymers. Polymers were assessed for their structural features, electronic and optical properties and their application in molecular electronic devices. Substantial progress has led to expansion of research activities into a number of different areas including conducting monolayers, 3rd order nonlinear optical polymers and newly designed materials with second and 3rd nonlinear optical properties. GRA

N91-12827# Lowell Univ., MA. Dept. of Chemistry.
STUDIES ON RELAXATION BEHAVIOR OF CORONA POLED AROMATIC DIPOLAR MOLECULES IN A POLYMER MATRIX
Braja K. Mandal, Y. M. Chen, R. J. Jeng, Toru Takahashi, Jan-Chan Huang, Jayant Kumar, and Sukant Tripathy 3 Aug. 1990 35 p Submitted for publication
(Contract N00014-90-J-1148)
(AD-A226512; TR-2) Avail: NTIS HC/MF A03 CSCL 07/6

A number of corona poled guest-host systems were investigated to understand the nature of interaction between the guest and the host molecules, the compatibility and relaxation behavior. This was carried out by studying the relaxation response of the nonlinear optical effects. Styrene acrylonotrile co-polymer was found to be the ideal matrix studied, since the polymer itself relaxes slowly subsequent to poling and it accommodates a wide range of nonlinear optical molecules differing in molecular structure and polarity. Retention of the second-harmonic intensity was emphasized as a measure of the relaxation and decay of the order parameters with time. Absorption characteristics of the poled and unpoled film are also described. GRA

N91-12828# Lowell Univ., MA. Dept. of Chemistry.
POLYHETEROCYCLE LANGMUIR-BLODGETT FILM
X. Q. Yang, J. Chen, P. D. Hale, T. Inagaki, T. A. Skotheim, D. A. Fischer, Y. Okamato, L. Samuelsen, Sukant Tripathy, and K. Hong (Massachusetts Inst. of Tech., Cambridge.) 3 Aug. 1990 18 p Submitted for publication
(Contracts N00014-90-J-1148; DE-AC02-76CH-00016)
(AD-A226513; TR-4) Avail: NTIS HC/MF A03 CSCL 07/6

Two types of polyheterocycles L-B films were fabricated: (1) copolymers of pyrrole and (3-alkyl pyrrole93-hexadecypyrrole and octadecylpyrrole) LB films; (2) mixtures of poly 3-alkyl thiophene and stearic acid L-B films. The orientation of single and multi layer films on platinum substrates have been studied by near-Edge X ray Absorption fine structure (NEXAFS- spectroscopy which also provides information about interaction between the aromatic groups and the metallic substrates. The alkyl substituted pyrrole monomers from highly ordered multi-layers L-B films with hydrocarbon chains perpendicular to the substrates, while the L-B films of polymers of pyrrole and alkylsubstituted pyrrole and more disordered. In the case of mixtures of poly(3-alkyl thiopene) and stearic acid L-B films, the hydrocarbon chain of the acid molecules are highly ordered. The poly (3-alkylthiopene) components, on the other hand, exhibit random orientation of the thiopen moieties. GRA

N91-12829# Lowell Univ., MA. Polymer Science Program.
COMB-LIKE POLYMERS CONTAINING NLO ACTIVE PENDANT GROUPS
Braja K. Mandal, Toru Takahashi, Mutsumi Maeda, Sai Kumar, Alexandre Blumstein, and Sukant Tripathy 3 Aug. 1990 26 p Submitted for publication
(Contract N00014-90-J-1148)
(AD-A226514) Avail: NTIS HC/MF A03 CSCL 07/6

The synthesis and characterization of new homo- and polymers containing p- extended (azomethine) active moiety separated by flexible methylene spacer were reported. All the synthesized monomers and polymers showed spectroscopic properties (NMR, IR, UV) in accordance with the proposed structures. Inherent solubility of polymers in common organic solvents permits the measurement of the distribution of molecular weight from gel permeation chromatography. Thermal characteristics of the polymers are also described. GRA

N91-12830# Lowell Univ., MA. Dept. of Chemistry.
NONLINEAR OPTICAL SPECTROSCOPY OF POLYMERS
Sukant Tripathy, Elizabeth Cavicchi, and Jayant Kumar 1989 72 p Submitted for publication
(Contract N00014-90-J-1148)
(AD-A226515; TR-8) Avail: NTIS HC/MF A04 CSCL 20/5

In linear optical spectroscopy, atomic and molecular structure is probed by light. The intensity, frequencies, and spectral width observed in the signal output from a sample (whether by reflection, transmission, absorption or scattering) reveal clues of energy transitions, and hence information about the electronic, vibrational, and other motional and structural aspects at the molecular level. Typically, the probing photons induce transitions between energy levels characteristic of the sample's molecules. Through analysis of the spectral output, the relative pattern of molecular levels can be reconstructed. Nonlinear optical spectroscopy on the other hand, rather than acting just as a probe, strongly perturbs the system. The strong optical electronic fields reorient the molecule's spatial positions, distort electron clouds, and excite uncharacteristic or forbidden transitions. GRA

N91-13321*# Auburn Univ., AL. Dept. of Materials Science and Engineering.
PLASTIC DEFORMATION MECHANISMS IN POLYIMIDE RESINS AND THEIR SEMI-INTERPENETRATING NETWORKS
Bor Z. Jang *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 64-65 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 11C

N91-13324*# College of William and Mary, Williamsburg, VA. Dept. of Chemistry.
THE EFFECTS OF THE SPACE ENVIRONMENT ON TWO ARAMID MATERIALS
Richard L. Kiefer *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 71-72 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 11C

N91-13334*# College of William and Mary, Williamsburg, VA. Dept. of Chemistry.
ADDITIVES TO REDUCE SUSCEPTIBILITY OF THERMOSETS AND THERMOPLASTICS TO EROSION FROM ATOMIC OXYGEN
Robert A. Orwoll *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 93-94 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N91-12831# Artech Corp., Chantilly, VA.
AN EVALUATION OF COMMERCIAL ADDITIVES FOR FUEL STABILITY ENHANCEMENT; BOTTLE TESTS AT 65 C Research and Development Report
Keith W. Flohr Apr. 1990 43 p
(Contract N00167-83-D-0012; NR Proj. R08-38)
(AD-A224868; ARTECH-J8350.48; DTRC/SME-CR-10-89) Avail: NTIS HC/MF A03 CSCL 21/4

In a joint program with NRL, the Center has been evaluating the effectiveness of using 10 commercial additives (and two Army additives) to suppress the formation of insolubles in mid-distillate fuels from different fuel sources and processes. The Center contracted ARTECH Corp. to evaluate the 10 additives at two concentration levels in each of four base fuels, using a bottle test similar to ASTM D4625, but run at 65 C rather than 43 C. Four of the additives were found to be effective, and six were slightly effective or innocuous. ARTECH also conducted two special studies. One evaluated the effect that preaged fuel had on insolubles formation in 65 C bottle tests; the other examined the effect of the condition of sampling and storage, e.g., air versus argon blanketing, epoxy-lined versus unlined storage cans, and wet versus dry storage. It was found that air blown or air blanketed fuel stored in unlined cans in the presence of moisture produced appreciably more insolubles than the same fuels under an argon blanket in a lined can in the absence of moisture. GRA

N91-12832# Fraunhofer-Inst. fuer Chemische Technologie, Berghausen (Germany, F.R.).
PROCESSES FOR ASSESSING THE THERMAL STABILITY OF HAN-BASED LIQUID PROPELLANTS: REVISION Final Report, Oct. 1985 - Oct. 1988
R. Hansen, E. Backof, H. J. DeGrieff, and Nathan Klein Jul. 1990 76 p
(Contract DAJA45-86-C-0056)
(AD-A224999; BRL-CR-635) Avail: NTIS HC/MF A05 CSCL 19/1

Liquid Propellants containing hydroxylammonium nitrate (HAN) react with metallic and non-metallic impurities. Two tests were developed to monitor gas evolution during storage at 90 C in 5-cc sealed glass ampoules or 3-cc glass containers fitted with miniature pressure transducers. Time to bursting of the ampoule or to a specific pressure in the container are the data obtained. The propellant's stability is dependent on pH with 2.1 being optimum. The effects of numerous metals, both as elements and ions, and plastics on the stability of LGP1846 are examined. Iron, copper, and vanadium ions caused the most reaction, and vanadium shows an effect at concentrations as low as 0.5 ppm. Magnesium, zinc, and manganese ions had no effect in storage life by this test criterion. Of the 30 metals and alloys investigated, 2 gunmetals and 3 stainless steels were subject to pronounced attack, but gold, silver, and tantalum remain unaffected. GRA

N91-12833# Ballistic Research Labs., Aberdeen Proving Ground, MD.
PROCEEDINGS OF THE 5TH ANNUAL CONFERENCE ON HAN-BASED LIQUID PROPELLANTS Final Report, Aug. 1988 - Aug. 1989
Josephine Q. Wojciechowski Jun. 1990 343 p Conference held in Aberdeen, MD, 22-24 Aug. 1989
(AD-A225016; BRL-SP-86) Avail: NTIS HC/MF A15 CSCL 21/9

This report contains the abstracts and viewgraphs of the papers presented at the Ballistic Research Laboratory Fifth Annual Conference on hydroxylammonium nitrate based liquid propellants, 22 to 24 August 1989. GRA

N91-12834# Southwest Research Inst., San Antonio, TX.
RE-EXAMINE LIQUID PROPELLANT NITROMETHANE HAZARD CLASSIFICATION PARAMETERS AND ADDRESS THE HAZARDS CLASSIFICATION OF VARIOUS SLURRY MIXTURES Final Report, 27 Mar. 1989 - 31 Jan. 1990
William R. Herrera and William L. Toliver Aug. 1990 37 p
(Contract DAAA21-88-R-0084)
(AD-A225625; ARAED-CR-90008) Avail: NTIS HC/MF A03 CSCL 19/1

Nitromethane is a potential candidate for the main energetic material in the U.S. Army Tactical Explosive System (TEXS). Storage of nitromethane in a general purpose warehouse is advantageous. The goal of this program was to examine the regulation concerning hazard classification, transportation, and storage of liquid propellant nitromethane. Agencies reviewed included United Nations, U.S. Department of Defense, U.S. Department of Transportation, and the Occupational Safety and Health Administration of the Department of Labor. At present, the United Nations, the U.S. Department of Transportation, and the Occupational Safety and Health Administration classify nitromethane as a flammable liquid. The Department of Defense classifies nitromethane as a mass detonating explosive. The Department of Defense classification does not permit storage in general warehouses. To store nitromethane in a general purpose warehouse, the nitromethane would have to be reclassified or the user would have to obtain a waiver. Waivers are difficult to obtain and are only valid for limited time periods. GRA

N91-12835# Southwest Research Inst., San Antonio, TX.
ADIABATIC COMPRESSION INITIATION CHARACTERISTICS OF LIQUID PROPELLANT NITROMETHANE UNDER DYNAMIC FILL CONDITIONS Final Report, 27 Mar. - 4 Aug. 1989
William R. Herrera and N. A. Messina Aug. 1990 46 p
(Contract DAAA21-88-R-0084)
(AD-A225626; ARAED-CR-90009) Avail: NTIS HC/MF A03 CSCL 21/2

SwRI used Princeton Combustion Research Laboratories (PCRL) to perform the designated tasks. Based upon their results of their limited laboratory-scale experiments in the field engineering assessments and preliminary findings from TEXS system modeling, PCRL concluded that the use of nitromethane in Tactical Explosive System is probably safe. PCRL has also advised that any hazards that may exist can be minimized by taking the following recommendations: Change off-loading nozzle valve to the type that shuts more slowly; Make sure that the 1.5 in. connecting pipe is PE (expandable) and not steel or other heavy walled pipe; Make sure that all valves in the 1.5 in. are wide open types and not constructed of steel. GRA

N91-12836# Lockheed Missiles and Space Co., Palo Alto, CA. Materials Sciences Lab.
MAGNETIC RESONANCE IMAGING STUDIES OF PROCESS RHEOLOGY Final Report
G. A. Lo, S. W. Sinton, A. W. Chow, A. B. Kunz, M. J. Seel, S. A. Marshall, and B. H. Suits (Michigan Technological Univ., Houghton.) 14 Aug. 1990 79 p
(Contract N00014-86-C-0724)
(AD-A225814; LMSC-F40416) Avail: NTIS HC/MF A05 CSCL 21/9

The objectives were to develop experimental and theoretical methods which will provide for improved methods of flow analysis as well as an improved understanding of the flow behavior of solid-filled polymeric suspensions. The objective of the experimental effort was to develop better magnetic resonance (MR) methods to detect and characterize inhomogeneities in uncured solid propellant. The specific experimental methods to be studied are nuclear magnetic resonance imaging methods with 100 microns or better spatial resolution for stationary propellant samples and to develop and characterize methods for imaging the flow of uncured propellants in process streams. Besides assisting the MR experimental effort, the purpose of the rheological effort, was to determine the effects of high solids loading on propellant flow behavior and their effects on continuous processing operations.

The objective of the theoretical modeling effort was to develop rigorous numerical models of macroscopic suspension flow in which the polymer-particle interaction physics are obtained from first principles with the air of providing a more thorough understanding of the origin and nature of the observed macroscopic behavior of concentrated solid-particle-filled polymeric suspensions. GRA

N91-12837# Geo-Centers, Inc., Lake Hopatcong, NJ.
DEVELOPMENT OF AQUEOUS AND NONAQUEOUS TITRIMETRIC METHODS FOR LIQUID PROPELLANTS Progress Report
J. P. Griff and G. Doyle Aug. 1990 34 p
(Contract DAAA21-88-D-0021)
(AD-A226186; ARAED-CR-90011) Avail: NTIS HC/MF A03 CSCL 19/1

The U.S. Army has made a commitment to develop liquid gun propellants as a potential replacement of solid propellants used in various gun systems. In order to monitor the propellants during storage, a study was conducted to develop analytical capabilities for this purpose. The storability of liquid propellants is required to determine whether there is any instability, its cause, and if necessary, its prevention. Titrimetry was selected to monitor two of the species present which were most illustrative of propellant conditions and critical to performance. In the course of this study, the merits of aqueous and nonaqueous techniques were discovered. As a result of this study, a capability is available to monitor some of the vital components and contaminants liquid propellants during storage. GRA

N91-12838# Ballistic Research Labs., Aberdeen Proving Ground, MD.
SHOCK TUBE STUDIES OF THE IGNITION OF TRIETHANOL AMMONIUM NITRATE IN NITROUS OXIDE: PRELIMINARY RESULTS Interim Report, Mar. - Sep. 1989
Richard A. Beyer Jun. 1990 27 p
(AD-A226397; BRL-TR-3120) Avail: NTIS HC/MF A03 CSCL 07/2

Triethanol ammonium nitrate (TEAN) has been shown to ignite and burn with significant light emission and pressure generation in a nitrous oxide/argon mixture heated in a shock tube. Ignition threshold is above 1300 K. Ignition delay is a function of pressure and temperature of the gas. Ignition in similar oxygen mixtures takes place in shorter times and at lower temperatures than with N2O. Calculations on the rate of thermal decomposition of the N2O indicate that this process may be important of the time scale of ignition. GRA

N91-12839# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
CO2 SOURCES FOR MICROALGAE-BASED LIQUID FUEL PRODUCTION
D. Feinberg and M. Karpuk Aug. 1990 35 p
(Contract DE-AC02-83CH-10093)
(DE90-000367; SERI/TP-232-3820) Avail: NTIS HC/MF A03

Researchers in the Aquatic Species Program at the Solar Energy Research Institute are developing species of microalgae that have high percentages of lipids, or oils. These lipids can be extracted and converted to diesel fuel substitutes. Because microalgae need carbon dioxide (CO2) as a nutrient, optimal microalgae growth occurs in CO2-saturated solutions. For this reason, the authors sought to identify possible large scale sources of CO2 for microalgae-based liquid fuels production. The authors concluded that several such promising sources exist. DOE

N91-12840# Amoco Oil Co., Naperville, IL. Dept. of Research and Development.
DIRECT CONVERSION OF LIGHT HYDROCARBON GASES TO LIQUID FUEL Quarterly Technical Status Report, Jan. - Apr. 1990
M. J. Foral 1990 12 p
(Contract DE-AC22-89PC-89866)
(DE91-000820; DOE/PC-89866/T1) Avail: NTIS HC/MF A03

Amoco Oil Company is investigating the direct conversion of light hydrocarbon gases to liquid fuels via partial oxidation. This report describes work completed in the first quarter of the two-year project (first quarter FY 1990). Task 1 of the work, preparation of the Project Management Plan, has been completed. Work was started and progress made on three other tasks during this quarter: Task 2. Modification of an existing Amoco pilot plant to handle the conditions of this project. Minor modifications were made to increase the maximum operating pressure to 1500 psig. Other more extensive modifications are being designed, including addition of an oxygen compressor and recycle system. Task 3.1. Evaluation of a Los Alamos National Laboratory methane oxidation kinetic model for suitability in guiding the experimental portions of this project. Task 3.2. Process variable (e.g., temperature, pressure, residence time) studies to determine optimal partial oxidation conditions. DOE

N91-12841# Lawrence Livermore National Lab., CA. Chemistry and Materials Science Dept.
USES OF FABRY-PEROT VELOCIMETERS IN STUDIES OF HIGH EXPLOSIVES DETONATION
R. D. Breithaupt and C. M. Tarver 27 Aug. 1990 9 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract W-7405-eng-48)
(DE91-000813; UCRL-102576; CONF-900756-50) Avail: NTIS HC/MF A02

The Fabry Perot has become an important and valuable tool by which explosive performance information can be obtained relatively easily and inexpensively. Principle uses of the Fabry Perot have been free surface, and particle velocity measurements in one dimensional studies of explosive performance. In the cylinder test, it has been very useful to resolve early wall motions. We have refined methods of characterizing new explosives i.e., equation of state, C-J pressure, via the cylinder shot, flat plate, and particle velocity techniques. All of these use Fabry Perot as one of the principle diagnostics. Each of these experimental techniques are discussed briefly and some of the results obtained. Modeling developed to fit Fabry-Perot results are described along with future testing. DOE

N91-12842# Amoco Oil Co., Naperville, IL.
DIRECT CONVERSION OF LIGHT HYDROCARBON GASES TO LIQUID FUEL Quarterly Report No. 8
M. J. Foral 1990 24 p
(Contract DE-AC22-89PC-89866)
(DE91-000870; DOE/PC-89866/T2) Avail: NTIS HC/MF A03

The objective of this program is to investigate the direct conversion of light gaseous hydrocarbons to liquid transportation fuels via a partial oxidation process. The process will be tested in existing pilot plant to obtain credible mass balances. Specific objectives to be met include determination of optimal process conditions, investigation of various processing options (e.g., feed injection, product quench, and recycle systems), and evaluation of an enhanced yield thermal/catalytic system. Economic evaluation of the various option will be performed as experimental data become available. The project is of two year's duration and contains three major tasks: Project Management Plan, Pilot Plant Modification, and Comparison of Preliminary Data With Los Alamos Model: We will determine if the kinetic model developed by Los Alamos National Laboratory can be used to guide our experimental effort. Other subtasks under Task 3 include: Pressure/Temperature/Reaction Time Effects; Study of Different Injection Systems: Different schemes for introducing and mixing reactants before or within the reactor will be evaluated theoretically and/or experimentally; Study of Different Quench Systems; Effect of Reactor Geometry; Effect of Reactor Recycle; and Enhanced-Yield Catalyst Study. DOE

N91-12843# Union Carbide Corp., South Charleston, WV. Solvents and Coatings Materials Div.
OPTIMUM CATALYTIC PROCESS FOR ALCOHOL FUELS FROM SYNGAS Progress Report, Jan. - Mar. 1990

B. Duane Dombek 28 Apr. 1990 50 p
(Contract DE-AC22-86PC-90013)
(DE91-000985; DOE/PC-90013/T13) Avail: NTIS HC/MF A04

The objectives of this contract are the following: (1) to discover and evaluate the catalytic properties of novel homogeneous, heterogeneous, or combination catalytic systems for the production of alcohol fuel extenders from syngas; (2) to evaluate, analytically and on the bench scale, novel reactor concepts for use in converting syngas to liquid fuel products; and (3) to develop on the bench scale the best combination of chemistry, reactor, and total process configuration to achieve the minimum product cost for conversion of syngas to liquid fuel products. Methanol production and heterogeneous catalysis utilizing transition elements supported on metal oxides with spinel structure are discussed. DOE

N91-12844# Delaware Univ., Newark. Dept. of Chemistry.
CHARACTERIZATION OF THE THERMAL DEGRADATION OF SELECTED ENERGETIC MATERIALS AND MIXTURES BY RAPID-SCAN FOURIER TRANSFORM INFRARED (RSFTIR) SPECTROSCOPY Final Report, Jun. 1989 - May 1990
Thomas B. Brill and Thomas P. Russell Jul. 1990 28 p
(Contract F98635-87-C-0130; AF Proj. 2303)
(AD-A226421; AFATL-TR-90-59) Avail: NTIS HC/MF A03 CSCL 17/1

The rapid thermal decomposition characteristics of alkylammonium nitrate salts in which the alkyl group is a hydrocarbon cage are described. Cubylammonium nitrate, cubane-1, 4-diammonium dinitrate, and penta undecane-4-exo-e-endo diammonium dinitrate were studied. Comparisons are made to the behavior of other alkylammonium nitrate salts upon fast thermolysis. GRA

N91-12845# Ballistic Research Labs., Aberdeen Proving Ground, MD.
MODELING OF COMPACTION WAVE BEHAVIOR IN CONFINED GRANULAR ENERGETIC MATERIAL Final Report, Sep. 1984 - Jan. 1990
Douglas E. Kooker Aug. 1990 101 p
(DA Proj. 1L1-62618-A1-FL)
(AD-A226435; BRL-TR-3138) Avail: NTIS HC/MF A06 CSCL 19/1

The successful transition to detonation in confined granular energetic material requires formation and maintenance of a strong compressive wave system which ignites unburned material in its path. The present investigation is directed toward an interpretation of this wave, before a full detonation wave has been established. For several years, the Naval Surface Warfare Center (NSWC) has been investigating the effects of impact on confined quiescent granular material with an apparatus known as the piston-driven-compaction (PDC) experiment. This report summarizes four modeling efforts developed by the author to understand the behavior of impact-generated compaction waves as observed by NSWC in the PDC experiment, often within the simplest possible framework. These include: (1) inert compaction waves governed by rate-dependent porosity adjustments, (2) quasi-steady compaction waves which account for wave-induced reaction and assume instantaneous adjustment to the equilibrium stress state, (3) collision of reactive compaction/shock waves, and (4) a transient reactive shock wave model which accounts for wave-induced reaction, gas-phase combustion of a reactive intermediate species, and transient combustion of the granular solid. GRA

N91-12846# Aerodyne Research, Inc., Billerica, MA.
EXPERIMENTAL SUPPORT FOR AND ANALYSIS OF INFRARED EMISSION DATA FROM SOLID PROPELLANT COMBUSTION TESTS Final Report, 1 Jul. 1988 - 30 Jun. 1990
K. D. Annen and Joda C. Wormhoudt 31 Aug. 1990 68 p
(Contract N00014-88-C-0492)
(AD-A226454; ARI-RR-798) Avail: NTIS HC/MF A04 CSCL 21/9

The objective of this program was to analyze infrared emission spectra from solid propellant combustion to obtain a better understanding of the chemical, physical, and radiative processes occurring in these flames. The spectra analyzed were obtained in the High Pressure Combustion Lab. of the Pennsylvania State Univ. using an infrared spectrometer and a strand burner. Comparing measured data with predictive models for emission from a substantial number of molecules whose radiative properties are well known allows determination of temperature and species concentrations in flame hot regions. Observed spectra can also be analyzed to yield radiative parameters for less known radiators. Preliminary work included estimates of flowfield parameters, detailed chemical kinetics calculations to track conversion of initial decomposition products, the construction of line and band radiation models for several molecules. Analysis of observed spectra began with an inspection to determine what molecules contributed spectral features. Several techniques were evaluated which used spectral features to evaluate hot region temperatures. These included using the widths of CO2 and H2O bands, the strengths ratios of low resolution H2O bands, and the peak intensities of resolved lines in HCR and HF bands. Relative concentrations were derived for several combustion product molecules which were in accord with propellant compositions. GRA

N91-12847# Institut Franco-Allemand de Recherches, Saint-Louis (France).
SUGGESTIONS FOR SUPPLEMENTARY EXAMINATIONS OF LOVA [VORSCHLAEGE FUER ZUSAETZLICHE UNTERSUCHUNGEN VON LOVA-TREIBLADUNGSPULVERN]
D. Grune 13 Aug. 1988 13 p In GERMAN Presented at the ICT Arbeitskreis LOVA, 28 Jun. 1988
(ISL-CO-228/88; ETN-90-98025) Avail: NTIS HC/MF A03

Low vulnerability gun propellants (LOVA) whose components have very different combustion velocities and dilatation coefficients are examined. It is advisable to determine the high pressure vivacity to simulate the conditions in the weapon at the time of the shooting. In case of anomaly, a combustion test with reaction interruption and analysis of the gaseous products is recommended to detect mechanical instabilities and check the achievement of the combustion reaction. These tests demonstrate possible improvements of the powders, such as the adaptation of the granulometry of the thickness of every component layer. ESA

N91-12565# IIT Research Inst., Bartlesville, OK. National Inst. for Petroleum and Energy Research.
ETBE IN GENERAL AVIATION AIRCRAFT ENGINES Abstract Only
William F. Marshall *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 54-55 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12566# Federal Aviation Administration, Atlantic City, NJ.
FLIGHT TESTING WITH ETANOL IN TURBOPROP ENGINES
Keith J. Biehl and Paul S. Demko *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 56-65 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology.*

No abstracts in this category.

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N91-12848# Redstone Scientific Information Center, Redstone Arsenal, AL.
BIBLIOGRAPHY ON METRICATION Final Technical Report, Jan. 1977 - Aug. 1989
C. R. Smith and M. B. Powel Aug. 1990 93 p
(AD-A224996; AD-E951513; RSIC-BIB-4) Avail: NTIS HC/MF A05 CSCL 14/2

This is a bibliography on metrication, the conversion to the International System of Units (SI), compiled from citations dated from January 1977 through July 1989. Citations include books, conference proceedings, newspapers, periodicals, government and civilian documents and reports. Subject indices for each type of citation and an author index for the entire work are included. A variety of subject categories such as legislation, construction, avionics, consumers, engineering, education, management, standards, agriculture, marketing and many others are available. GRA

N91-12849# Washington Univ., Seattle. Dept. of Engineering.
SLOPE REINFORCEMENT DESIGN USING GEOTEXTILES AND GEOGRIDS M.S. Thesis
Darrell M. Setser 1990 71 p
(AD-A226113) Avail: NTIS HC/MF A04 CSCL 13/3

A geotextile is defined by ASTM as: any permeable textile material used with foundation, soil, rock, earth, or any other geotechnical engineering related material, as a integral part of a man-made project, structure, or system. A geogrid is defined as: any geotextile-related material used in a similar manner to geotextiles. They are usually made of plastic, but can be metal or wood. Geotextiles and geogrids are collectively referred to as geosynthetics in this paper. Geosynthetic reinforcement of slopes is a relatively new option available to the civil engineer. Slope angles can be increased and 'poor' soil can be used to construct economical soil-geosynthetic facilities. Uncertainties exist in the complex interaction between the soil and the geosynthetic but there are numerous procedures which ignore this in the design. The design procedures available may be conservative yet still may be an economical alternative when compared to more conventional options. GRA

N91-12850# Sandia National Labs., Albuquerque, NM. Intelligent Machine Principles Div.
THE ROBOTIC EDGE FINISHING LABORATORY
Clifford S. Loucks and Colin B. Selleck Aug. 1990 30 p
(Contract DE-AC04-76DP-00789)
(DE91-000475; SAND-90-0440) Avail: NTIS HC/MF A03

The Robotic Edge Finishing Laboratory at Sandia National Laboratories is developing four areas of technology required for automated deburring, chamfering, and blending of machined edges: (1) the automatic programming of robot trajectories and deburring processes using information derived from a CAD database; (2) the use of machine vision for locating the workpiece coupled with force control to ensure proper tool contact; (3) robotic deburring, blending, and machining of precision chamfered edges; and (4) in-process automated inspection of the formed edge. The Laboratory, its components, integration, and results from edge finishing experiments to date are described here. Also included is a discussion of the issues regarding implementation of the technology in a production environment. DOE

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N91-12851# National Telecommunications and Information Administration, Boulder, CO. Inst. for Telecommunication Sciences.
DISTRIBUTION OF THE DAILY foF2 ABOUT THE MONTHLY MEDIAN
M. W. Sowers and M. PoKempner May 1990 192 p Sponsored by Army
(PB90-252404; NTIA-90-263) Avail: NTIS HC/MF A09 CSCL 20N

Data from 21 ionospheric sounding stations in the Northern and Southern Hemispheres were used to characterize the day-to-day variation in the critical frequency of the F2 layer of the ionosphere. Variability in the critical frequencies are analyzed monthly and diurnally for quiet magnetic conditions during both low and high solar periods. In addition, variations in the F2 layer critical frequency are presented for active magnetic conditions during equinox periods. Tables of variabilities for each ten degree increment in magnetic latitude are also provided in the report. The dependence of variations in the critical frequency with the solar cycle index IG12 is also discussed. GRA

N91-12852# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems Div.
ASSESSMENT OF THE SYSTEM RELIABILITY OF MODERN COMMUNICATIONS SATELLITE CLUSTERS
Christian Riedl 1989 10 p
(MBB-UK-0033-89-PUB; ETN-90-97851) Avail: NTIS HC/MF A02

The problems relating to the calculation of the reliability of modern communications satellites and satellites clusters are discussed. Examples of satellite projects are given, and components required for redundancy and the redundancy concepts are explained. A method for the calculation of the reliability of complex payloads and satellite clusters, the Markov chain analysis, is given. ESA

N91-12853# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems Div.
A CENTRAL DATA MANAGEMENT UNIT FOR A MODERN COMMUNICATION SATELLITE SYSTEM
Stefan Thuerey and Eberhard Groegor 1989 12 p Presented at 1st European Conference on Satellite Communications, Munich, Fed. Republic of Germany, 28-30 Nov. 1989
(MBB-UK-0082-89-PUB; ETN-90-97852) Avail: NTIS HC/MF A03

The designs of the Central Data Management Unit (CDMU), attitude and orbital control computer and remote terminal units are described. Analysis of requirements and technological capabilities of the data management subsystem lead to the concept of integrated control and data management onboard a spacecraft, combining all data acquisition, routing and evaluation functions into one unified system. These functions include all control and monitoring operations, the attitude and orbit control system and the telemetry and telecommand system. ESA

N91-12854# BBN Systems and Technologies Corp., Cambridge, MA.
MONITORING CAP8 AND SURAP NETWORKS (SRNTN-12)
Michael Cote 1990 32 p
(Contract MDA903-83-C-0173)
(AD-A224992; AD-E951514; BBN-7165) Avail: NTIS HC/MF A03 CSCL 25/2

Network monitoring is necessary for debugging protocols, measuring network performance, determining routes, and predicting network functionality. These tasks require data collection. Network Monitoring systems must poll Low-Cost Packet Radios (LPRs) for specific types of data, then process it for an operator. The Monitoring Data Packets (MDPs) specified in this document provide a flexible mechanism for monitoring systems to collect this data from an LPR network. Specific SURAP network monitoring applications that require MDPs are: Siting Aids for deploying the LPRs, NetMan for global network management, and the NIU (Network Interface Unit) for local network information. This document specifies the MDP formats for SURAP1 and SURAP2. These formats (see Appendix A) are the result of merging the packet radio PDP (Performance Data Packet) and the DIP (Device Information Packet). The remainder of the data is derived from the CAP LROP and from information which in the CAP8 networks, has been available only from the PR itself using the XRAY tool. GRA

N91-12855# Stanford Linear Accelerator Center, CA.
COMPUTER DETERMINATIONS OF THE PROPERTIES OF WAVEGUIDE LOADED CAVITIES
Norman M. Kroll and Xin-Tian Lin (California Univ., San Diego, La Jolla.) Sep. 1990 3 p Presented at the Linear Accelerator Conference, Albuquerque, NM, 10-14 Sep. 1990
(Contract DE-AC03-76SF-00515)
(DE91-000463; SU-SLAC-PUB-5345; CONF-9009123-33) Avail: NTIS HC/MF A01

Two recently developed computer methods to determine the resonant frequency and Q(sub ext) of waveguide loaded cavities are described. An application of these methods to a cavity of simple form with a range of coupling apertures is presented. The methods are found to be in good agreement with each other and also with the experiment. DOE

N91-12856# Office of Naval Research European Office, FPO New York, NY.
EUROPEAN TELECOMMUNICATIONS CONFERENCE. STRATEGIC PLANNING FOR THE 1990S
J. F. Blackburn 29 Jun. 1990 14 p Conference held in Brussels, Belgium, 9-10 May 1990
(AD-A225521; ONREUR-90-6-C) Avail: NTIS HC/MF A03 CSCL 25/5

The European Telecommunications Conference Strategic Planning for the 1990s provided information to delegates and their companies on strategic planning for the European market, particularly after the advent of the European Single Market at the end of 1992. The conference objective was to examine the impact of the initiatives of the European Commission (EC) and the changing attitudes to service provision by public and private sector organizations on industry and marketing. Organized by Blenheim Online and Logica, 40 delegates attended this conference, mainly from Europe, but with a few from the U.S. The papers were designed to illuminate such questions as emerging market sectors, impact of U.S telecommunications organizations in Europe, mergers and acquisition, standards, and value-added services. GRA

N91-12857# Office of Naval Research European Office, FPO New York, NY.
CABLE TELEVISION AND SATELLITE BROADCASTING
J. F. Blackburn 31 May 1990 16 p Conference held in 1990
(Contract ONREUR-90-2-C)
(AD-A225523) Avail: NTIS HC/MF A03 CSCL 25/2

Sponsored by the Financial Times, this 2-day conference was the eighth in the annual series. This particular conference marks the end of the first year of the Sky Television network's operation in the U.K. The conference was held just before British Satellite Broadcasting (BSB) goes into operation. With speakers from the U.K., the U.S., France, Japan, and the Netherlands, attendance exceeded all previous conferences. The 400 participants came mainly from the U.K., but also represented were France, the Netherlands, U.S., Australia, Spain, Norway, Canada, Switzerland, Denmark, Federal Republic of Germany (FRG), Finland, Monaco, Belgium, South Africa, Italy, Luxembourg, Irish Republic, and Malta. GRA

N91-12858# Prometheus, Inc., Sharon, MA.
NEW APPROACHES TO BEAMFORMING, NULL STEERING, AND FILTERING Final Report, 1 Dec. 1988 - 31 Mar. 1990
Michael J. Barrett, John J. Benedetto, Stephen Boyd, James S. Byrnes, Andre Giroux, Nasser M. Khraishi, Kenneth S. Miller, Donald J. Newman, Gerald Ostheimer, and Richard Roy et al 11 Jul. 1990 207 p
(Contract F49620-88-C-0028; AF Proj. 3005)
(AD-A225737; AFOSR-90-0866TR) Avail: NTIS HC/MF A10 CSCL 20/14

This final report consists of ten sections. The first is a report describing our abilities in the co-site radio frequency interference (RFI) problem. The second is the paper, Heisenberg Wavelets and the Uncertainty Principle, which will be expanded upon and submitted to the appropriate technical journal. The third is a revised version of the paper, A Multidimensional Wiener-Wintner Theorem and Spectrum Estimation, which will appear shortly in the Transactions of the American Mathematical Society. The fourth is the expository paper, Problems on Polynomials with Restricted Coefficients Arising from Questions in Antenna Theory, to appear shortly in the Proceedings of the 1989 NATO Advanced Study Institute on Fourier Analysis and its Applications. The fifth is the paper, An Ideal Omnidirectional Transmitting Array, and Optimal Peak Factor Array, for Less Than Half-wavelength Spacing, to be submitted shortly to the IEEE Transactions on Antennas and propagation. The sixth is the revised paper, Properties on the Unit Circle of Polynomials with Unimodular Coefficients, which just appeared in the Proceedings of the American Mathematical Society. The seventh gives an overview of awd, which is our new method of choosing shading coefficients, based on a convex programming approach. The eight is the latest revision of the paper, A Specification Language Approach to Solving Convex Antenna Weight Design Problems, which will be submitted shortly to the appropriate technical journal. The ninth is version 3.0 of the awd user's manual, incorporation several improvements which have been added recently. Several specific awd examples which were done for the Naval Underwater Systems Center constitute the tenth and final section. GRA

N91-12859# Naval Postgraduate School, Monterey, CA.
EVALUATION OF SYSTEM IDENTIFICATION ALGORITHMS FOR ASPECT-INDEPENDENT RADAR TARGET CLASSIFICATION M.S. Thesis
Peter D. Larison Dec. 1989 159 p
(AD-A225918) Avail: NTIS HC/MF A08 CSCL 17/9

A radar target, acting as a scatterer of an incident electromagnetic wave, can be considered as a linear time-invariant system. Previous work has shown that the target's pole locations are independent of the incident electromagnetic excitation, including incident wave shape, aspect and polarization. This thesis develops the Kumaresan-Tufts and Cadzow-Solomon signal processing algorithms into computer routines and evaluates their pole extraction performance. Data used to evaluate the extraction algorithms includes synthetic and integral equation generated signals with additive noise, in addition to measurements of scattering by scale models made in an anechoic chamber. GRA

N91-12860# Michigan Univ., Ann Arbor. Radiation Lab.
COMPUTER PROGRAM FOR MODE SEARCH IN PARTIALLY-FILLED WAVEGUIDE
T. E. VanDeventer and P. B. Katehi 12 Mar. 1990 33 p
(Contract DAAL03-87-K-0088)
(AD-A225943; ARO-23836.14-EL) Avail: NTIS HC/MF A03 CSCL 12/5

The FORTRAN program PFW.FTN (Partially-Filled Waveguide) was written to compute the complex propagation constant of the hybrid modes propagating in an inhomogeneously-filled waveguide with any number of lossy substrates and non-perfectly conducting walls. GRA

N91-12861# CyberCom Corp., Arlington, VA.
UHF RADIOWAVE PROPAGATION THROUGH FORESTS Final Report, Mar. 1989 - Jun. 1990
R. H. Lang, A. Schneider, and F. J. Altman Jul. 1990 61 p
(Contract DAAL03-89-C-0008)
(AD-A225972; CTR-121-01; ARO-26428.1-EL-S) Avail: NTIS HC/MF A04 CSCL 20/14

Using the U.S. Army's Wideband Propagation Measurement System, radio wave propagation experiments were twice conducted in Coventry, Connecticut - first in August 1987 and again in November 1987 after the autumnal leaf fall. A selected subset of these data, representing nearly one-hundred experiments conducted over different distances with different frequencies, polarizations, and antenna heights, were analyzed and trends established which relate delay spread to the environmental and radiophysical parameters characterizing the propagation path. GRA

N91-12862# Rome Air Development Center, Griffiss AFB, NY.
PROCEEDINGS OF THE 1989 ANTENNA APPLICATIONS SYMPOSIUM. VOLUME 1
Paul Mayes et al Mar. 1990 349 p Symposium held on 20-22 Sep. 1989
(AD-A226021; RADC-TR-90-42-Vol-1) Avail: NTIS HC/MF A15 CSCL 09/1

The Proceedings of the 1989 Antenna Applications Symposium is a collection of state-of-the-art papers relating to phased array antennas, multibeam antennas, satellite antennas, microstrip antennas, reflector antennas, HF, VHF, UHF, and various other antennas. GRA

N91-12863# Rome Air Development Center, Griffiss AFB, NY.
PROCEEDINGS OF THE 1989 ANTENNA APPLICATIONS SYMPOSIUM. VOLUME 2
Paul Mayes et al Mar. 1990 276 p Symposium held on 20-22 Sep. 1990
(AD-A226022; RADC-TR-90-42-Vol-2) Avail: NTIS HC/MF A13 CSCL 09/1

The Proceedings of 1989 Antenna Applications Symposium is a collection of state-of-the-art papers relating to phased array antennas, multibeam antennas, satellite antennas, microstrip antennas, reflector antennas, HF, VHF, UHF, and various other antennas. GRA

N91-12864# Naval Postgraduate School, Monterey, CA.
A GENERIC SET OF HF ANTENNAS FOR USE WITH SPHERICAL MODEL EXPANSIONS M.S. Thesis
Nedim Katal Mar. 1990 74 p
(AD-A226061; NPS62-90-005) Avail: NTIS HC/MF A04 CSCL 09/1

An antenna engineering handbook and database program has been constructed by engineers at the Lawrence Livermore National Laboratory (LLNL) using the Numerical Electromagnetics Code (NEC) antenna modeling program to prepare data performance on tactical field communication antennas used by the Army. It is desirable to have this information installed on a personnel computer (PC), using relational database techniques to select antennas based on performance criteria. This thesis obtains and analyses current distributions and radiation pattern data by using NEC for the following set of four (4) high frequency (HF) tactical generic antennas to be used in future spherical mode expansion work: a quarter wavelength basic whip, a one-wavelength horizontal quad Loop, a 564-foot longwire, and a sloping vee beam dipole. The results of this study show that the basic whip antenna provides good groundwave communication, but it has poor near vertical incident skywave (NVIS) performance. The current distribution has the characteristics of standing waves. The horizontal quad loop antenna is good for night vision imaging systems (NVIS) and medium range skywave communications. The current distribution is sinusoidal and continuous around the loop. The long wire antenna allows short, medium and long range communications and a standing wave current distribution occurs along the antenna axis due to non-termination. The sloping vee beam antenna favors long range communication and the current distribution is mainly that of travelling sinusoidal waves. Because of their well-known efficiency, the basic whip and quad loop can be used as reference standards for the spherical mode expansion work. The longwire and sloping vee beam antenna are unwieldy, but they are effective as base station antennas. GRA

N91-12865# Rome Air Development Center, Griffiss AFB, NY.
OPTICALLY LINKED EHF ANTENNA ARRAY In-House Report, Apr. 1987 - Apr. 1990
Salvatore L. Carollo, Anthony M. Greci, and Richard N. Smith Jul. 1990 26 p
(AD-A226101; RADC-TR-90-183) Avail: NTIS HC/MF A03 CSCL 20/6

This report covers the work done under Task 5 of Project 45194263 entitled, Communications Adaptive Array Processor Evaluation. Adaptive antenna technology has been an area of interest for many years. The progress to date can be characterized by extensive research on algorithms and processing architectures, development of a large number of prototype systems and fielding of a few systems. Adaptive antenna systems normally consist of two or more antenna elements, two or more receivers, amplitude and phase weighting networks for one or more elements and a signal combiner. For some applications the size, weight, power consumption and cost or multiple receivers, antenna elements and associated radio frequency (RF) cabling can be limiting factors. In spite of these limitations, the impressive interference cancellation capabilities of adaptive antenna system is highly desirable. Recent advances in photonics technology could provide solutions to the limitations described above. RF modulated lasers, optical cabling and optical detectors could reduce much of the size, weight, power consumption, and cost of conventional adaptive array systems. This report covers the design, implementation, and testing of an optically linked adaptive antenna array. GRA

N91-12866# Wright Research Development Center, Wright-Patterson AFB, OH.
INTEGRATED ELECTROMAGNETIC SYSTEM SIMULATOR (IESS) POST RUN ANALYSIS WITH DECALC/DECGRAPH AND A TRUTH DATA FORMATTING PROGRAM WRITTEN IN FORTRAN
Dana L. Howell 8 Feb. 1990 112 p LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(AD-A226116; WRDC-TM-90-100-AAAI) Avail: NTIS HC/MF A06 CSCL 20/14

The Analysis and Evaluation Group (WRDC/AAAI-4) has been tasked with integrating the Integrated Communication, Navigation, Identification Avionics (ICNIA) system into the Integrated Electromagnetic System Simulator (IESS) facility and performing Test and Evaluation (T and E) on the ICNIA system. This responsibility has led to the need to examine IESS post run analysis techniques to determine areas that may need enhancement. DECALC and DECGRAPH are Digital Equipment Corporation (DEC) software products that produce accurate graphical representations of data through an integrated spreadsheet/graphics package very similar to the PC-based LOTUS program. This memorandum describes the use of DECALC/DECGRAPH in performing post run analysis of data produced from IESS scenarios. A FORTRAN program is also described which has been written to reformat post run text data from the IESS. This reformatted data output is easier to read and can be imported directly into DECALC and graphed using DECGRAPH. IESS produces a dynamic electromagnetic environment consisting of complex Radio Frequency (RF) waveforms in the 2 MHz to 5 GHz frequency range that closely simulates the environment which occurs during actual flight. Scenarios are defined through a Host processor (VAX 11/7800). GRA

N91-12867# Rome Air Development Center, Griffiss AFB, NY.
INVESTIGATION OF A BENT WIRE CHIRAL: ELECTROMAGNETIC SCATTERING
Allan C. Buck Oct. 1989 33 p

(AD-A226218; RADC-TR-89-264) Avail: NTIS HC/MF A03 CSCL 20/14

The bistatic scattering from a bent wire chiral has been analyzed and a computer modeling capability has been developed. A simple model was also developed to aid in interpreting the chiral body's scattering. Behavior of the scattered fields was investigated as the chiral's geometry was varied. Data was presented that would be useful in the design of chiral media. GRA

N91-12868# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.

SOFT CONSTRAINED MINIMUM VARIANCE BEAMFORMING

Barry VanVeen 1990 5 p Submitted for publication (Contract DAAL03-89-K-0141)
(AD-A226260; ARO-26460.3-EL) Avail: NTIS HC/MF A01 CSCL 20/14

Often linear or hard constraints are employed in minimum variance beamforming to prevent the beamformer from cancelling the signal. Here an inequality or soft constraint on the mean squared error between a desired response and the actual response of the beamformer in the signal direction is utilized. The constraint is purposely chosen to permit distortion of the signal in order to obtain improved interference cancellation. Assuming a known signal direction and spectral shape, a proof is given showing that the signal to noise ratio improves as the mean square distortion increases. Properties of this beamforming are discussed. Simulations illustrate the utility of soft constraints. GRA

N91-12869# Naval Postgraduate School, Monterey, CA.

THE EFFECT OF THREE VARIABLES ON SYNTHETIC SPEECH INTELLIGIBILITY IN NOISY ENVIRONMENTS M.S. Thesis

Joyce C. Munlin Mar. 1990 75 p
(AD-A226610) Avail: NTIS HC/MF A04 CSCL 25/4

Military Command and Control (C2) requires easy access to information needed for the commander's situation assessment and direction of troops. Providing this information via synthetic speech is a viable alternative, but additional information is required before speech systems can be implemented for C2 functions. An experiment was conducted to study several factors which may affect the intelligibility of synthetic speech. The factors examined were: (1) speech rate; (2) synthetic speech messages presented at lower, the same, and higher frequencies than background noise frequency; (3) voice richness; and (4) interactions between speech rate, voice fundamental frequency, and voice richness. Response latency and recognition accuracy were measured. Results clearly indicate that increasing speech rate leads to an increase latency and a decrease in recognition accuracy, at least for the novice user. No effect of voice fundamental frequency or richness was demonstrated. GRA

N91-12870# Naval Research Lab., Washington, DC. Target Characteristics Branch.

MISSING PULSE CLUTTER PROCESSING Interim Report

Michael J. Steiner and Frank F. Kretschmer, Jr. 31 Aug. 1990 22 p Sponsored by ONR, Arlington, VA
(AD-A226616; NRL-9273) Avail: NTIS HC/MF A03 CSCL 17/9

Missing pulses resulting from RFI blanking, ambiguous range returns when no filter pulses are used, or eclipsing can seriously degrade conventional clutter filters. The effects are investigated of a missing pulse on uncompensated and optimum clutter filters. The maximum improvement factor method of Emerson and other methods are compared to the optimum filtering. New methods and results using a minimax log energy search method are described and are shown to provide performance and/or implementation complexity advantages. GRA

N91-12871# Centro Studi e Laboratori Telecomunicazioni, Turin (Italy).

[ACTIVITIES REPORT OF THE CENTRO STUDI E LABORATOI TELECOMUNICAZIONI] Annual Report, 1989 [CSELT: RAPPORTO ANNUALE 1989]

1990 75 p In ITALIAN
(ETN-90-97803) Avail: NTIS HC/MF A04

The activities described include research on intelligent networks, integrated networks, asynchronous transfer mode CMOS cells, ground antenna, fiber amplifiers, optoelectronic devices, voice control, and optical networks. ESA

N91-12872# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.

EXAMINATION OF PREDICTION CODING OF SPEECH SIGNALS WITH MULTIPULSE EXCITATION FUNCTIONS Ph.D. Thesis [UNTERSUCHUNGEN ZUR PRAEDIKTIVEN CODIERUNG VON SPRACHSIGNALEN MIT MEHRFACHIMPULS-ANREGUNGSFUNKTIONEN]

Wolfgang Granzow 1990 193 p In GERMAN
(ETN-90-98186) Avail: NTIS HC/MF A09

The examination of the prediction coding process with the Multi Pulse excited Linear Predictive Coding (MDLPC) with a view to digitalizing speech signals with phone bandwidth 0.3 to 3.4 kHz in bit rate range from about 4 to 16 kbits/s was described. The most important application of this process is in the field of digital mobile radio speech transmission. It was shown how the MDLPC principle is classified in the process of adaptive predictive vector quantization. All the processes for calculating the excitation function were simulated in a digital computer and compared. The possibilities of reduction of perceptible distortions by using masking effects were examined and discussed. The objective quality of the coding process was evaluated by measuring the signal to noise ratio, and the subjective quality by auditory comparisons of coded speech specimens. ESA

N91-12578# Computer Technology Associates, Inc., McKee City, NJ.

SUMMARY OF THE FAA LOW DATA RATE VOICE CODEC EVALUATION AND DEMONSTRATION PROGRAM

Markus R. Grable *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 364-372 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12696*# Draper (Charles Stark) Lab., Inc., Cambridge, MA. Fault-Tolerant Systems Div.

A HIGHLY RELIABLE, AUTONOMOUS DATA COMMUNICATION SUBSYSTEM FOR AN ADVANCED INFORMATION PROCESSING SYSTEM

Gail Nagle, Thomas Masotto, and Linda Alger *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 11 p (For primary document see N91-12682 04-08)
(Contracts NAS1-17666; NAS1-18565)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive CSCL 17B

N91-13311*# University of Central Florida, Orlando. Dept. of Electrical Engineering.

MUTUAL COUPLING BETWEEN CIRCULAR APERTURES ON AN INFINITE CONDUCTING GROUND PLANE AND RADIATING INTO A FINITE WIDTH SLAB

Christos Christodoulou *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 43-45 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20N

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N91-12873*# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.
HIGH POWER DENSITY dc/dc CONVERTER: COMPONENT SELECTION AND DESIGN Interim Report, Jul. 1988 - Jun. 1989
Deepakraj M. Divan 1989 86 p
(Grant NAG3-804)
(NASA-CR-186965; NAS 1.26:186965) Avail: NTIS HC/MF A05 CSCL 09A

Further work pertaining to design considerations for the new high power, high frequency dc/dc converters is discussed. The goal of the project is the development of high power, high power density dc/dc converters at power levels in the multi-kilowatt to megawatt range for aerospace applications. The prototype converter is rated for 50 kW at a switching frequency of 50 kHz, with an input voltage of 200 Vdc and an output of 2000 Vdc. The overall power density must be in the vicinity of 0.2 to 0.3 kg/kW. Author

N91-12874*# Wilson Greatbatch Ltd., Clarence, NY.
MANUFACTURE AND EVALUATION OF Li/BCX DD CELLS Final Report
S. Meyer and E. Takeuchi Jun. 1990 225 p
(Contract NAS9-18142)
(NASA-CR-185610; NAS 1.26:185610; DRD-SE-1299-T) Avail: NTIS HC/MF A10 CSCL 09C

This project is divided into four main tasks: cell manufacture, acceptance, and lot certification of cells, performance testing of cells, and abuse testing of cells. Lithium/bromine chloride in thionyl chloride (Li/BCX) 149 DD cells (PN 3B2085-XA) were built according to the provisions of Electrochem Industries Quality Plan 17096. Acceptance and lot certification testing was performed according to NASA JSC Document EP5-83-025, Revision B. Acceptance testing included open circuit and load voltage check, visual examination, size and weight measurements, and high temperature exposure. Lot certification tests were performed for capacity performance and for performance under conditions of thermal and electrical abuse. These tests included 149 C exposure, capacity discharge, fuse check, high temperature exposure, high rate discharge, short circuit, vibration, and overdischarge testing. A quantity of 200 cells was delivered to Johnson Space Center for life test evaluation. A parametric evaluation of the capacity discharge of Li/BCX DD cells was performed over a variety of temperatures and discharge rates. This testing served to map the performance capability of the cell. Tests were also performed over a variety of electrical and thermal abuse conditions. Abuse tests included short circuit, charging, overdischarge, high temperature exposure, shock, and vibration. Author

N91-12875*# Clemson Univ., SC. Dept. of Ceramic Engineering.
DEVELOPMENT AND EVALUATION OF SUPERCONDUCTING CIRCUIT ELEMENTS Final Report
Gene H. Haertling, Burtrand Lee, Dennis Hsi, Vibhakar Modi, and Matt Marone 31 Oct. 1990 102 p
(Grant NAG1-820)
(NASA-CR-187344; NAS 1.26:187344) Avail: NTIS HC/MF A06 CSCL 09C

An approach to the application of high Tc ceramic superconductors to practical circuit elements was developed and demonstrated. This method, known as the rigid-conductor process (RCP), involves the combination of a pre-formed, sintered, and tested superconductor material with an appropriate, rigid substrate via an epoxy adhesive which also serves to encapsulate the element from the ambient environment. Emphasis was on the practical means to achieve functional, reliable, and reproducible components. Although all of the work described in this report involved a YBa2Cu3Osub(7-x) high Tc superconductor material, the techniques developed and conclusions reached are equally applicable to other high Tc materials. Author

N91-12876# National Inst. of Standards and Technology, Gaithersburg, MD. Automated Production Technology Div.
NEED FOR RESEARCH IN ELECTRONICS ASSEMBLY TECHNOLOGY
H. T. Bandy Jul. 1990 32 p Sponsored by Harry Diamond Labs, Adelphi, MD
(PB90-250101; NISTIR-4368) Avail: NTIS HC/MF A03 CSCL 09C

The National Institute of Standards and Technology assisted the Harry Diamond Laboratories in an effort to develop plans for a new program of research in electronics assembly technology. The need for research was investigated in the domains of precision engineering, system integration, and process control. Rather than engineering design problems, the emphasis was on principles, techniques, and standards that could help eliminate obstacles to widespread adoption of state-of-the-art technology in assembly plants. Current popular assembly methods as well as emerging new trends were studied. Research projects are recommended in the following areas: (1) flexibility of equipment, (2) precision handling of components, (3) equipment interfaces, (4) equipment programmability, and (5) statistical process control. GRA

N91-12877# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
SECONDARY SIDE CMOS FEEDBACK CONTROL INTEGRATED CIRCUIT M.S. Thesis
William P. Wilkinson Jun. 1990 133 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224580; AD-E501254; AFIT/CI/CIA-90-051) Copyright Avail: NTIS HC/MF A07 CSCL 20/3

The development is described of a CMOS secondary side feedback control integrated circuit for a power converter. The feedback controller was designed for use in miniaturized point-of-load dc-dc switching power converters. The integrated circuit compares the output of the converter to an on-chip reference voltage and encodes the resulting error signal on an amplitude modulated carrier square wave. The circuit was designed and verified with extensive computer simulations before being fabricated through the MOSIS program in the 2 micron, nwell CMOS process. Errors in the integrated circuit layout were repaired using a Focused Ion Beam, demonstrating the beam's ability to make both connections and detachments on integrated circuits. The design included four major subcells, a temperature independent bandgap voltage reference, an error amplifier, an oscillator, and an amplitude modulator. Subcell testing demonstrated the suitability and versatility of CMOS for high density power converter control circuitry. GRA

N91-12878# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
A MONOLITHIC DUAL-GATE MESFET CIRCUIT FOR L-BAND MIXERS M.S. Thesis
Jerome J. Akerson 1990 119 p
(AD-A224686; AFIT/CI/CIA-90-049) Avail: NTIS HC/MF A06 CSCL 09/1

An L-band GaAs dual-gate MESFET monolithic mixer was developed to convert a 1.575 GHz signal to an intermediate frequency of 173 MHz with a local oscillator frequency of 1.402 GHz. In order to reduce chip size, active baluns and buffer amplifiers were combined with two dual-gate MESFET mixers to form a single integrated balanced mixer circuit. The active baluns eliminate the need for large passive baluns, and the buffer amplifiers replace the IF matching networks; thus, easing integration at L-band frequencies. Circuit size is 1.15 X 1.8 mm. The circuit was commercially fabricated; however, this thesis describes only the design, simulation, and layout of the mixer circuit. GRA

N91-12879# Sandia National Labs., Albuquerque, NM. Microwave Physics Div.
MODE-STIRRED CHAMBER MEASUREMENTS OF THE SHIELDING EFFECTIVENESS OF SELECT CABLES AND CONNECTORS
Richard P. Toth and Larry D. Bacon Jun. 1990 43 p
(Contract DE-AC04-76DP-00789)
(DE91-000466; SAND-90-1544) Avail: NTIS HC/MF A03

The shielding effectiveness (SE) was determined experimentally at microwave frequencies of various types of single- and double-braided cables and connectors typical of systems that have been hardened to electromagnetic fields. A laboratory-sized reverberation chamber and the techniques used to measure the SE of several interconnecting components are described. Graphical results are presented, along with smoothed overlay plots for each category of measurements. The overlay plots indicate the general trends in the raw data and highlight the differences between tested components. DOE

N91-12880# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
[RESEARCH PROGRAMS AT THE RESEARCH LABORATORY OF ELECTRONICS] Progress Report No. 132, 1 Jan. - 31 Dec. 1989
Jonathan Allen and Daniel Kleppner 1990 374 p
(AD-A225355) Avail: NTIS HC/MF A16 CSCL 14/2

The Research Laboratory of Electronics (RLE) was established in 1946 as the Institute's first interdepartmental laboratory. Originally organized under the joint sponsorship of the Departments of Physics and Electrical Engineering, RLE has broadened its interests to cover a wide range of research. The RLE environment provides both the freedom of action essential in an academic institution and the availability of large-scale laboratory facilities and services required by researchers. RLE's interdisciplinary setting offers many opportunities for creative and collaborative research. By fostering this powerful combination of research and education, RLE effectively penetrates beyond the horizon of new ideas and information. RLE Progress Report Number 132 describes research programs at RLE for the period January 1 through December 31, 1989. Each chapter of the Progress Report contains both a statement of research objectives and a summary of research efforts for research projects listed. There are three appendices at the end of the report: Appendix A is a bibliography of RLE publications and papers presented by RLE staff during 1989; Appendix B is a roster of current RLE staff; and Appendix C is an index of RLE sponsors. GRA

N91-12881# Naval Postgraduate School, Monterey, CA.
DESIGN OF A SENSOR-BLENDING KALMAN FILTER FOR THE R2P2 FINE-TRACKING SYSTEM M.S. Thesis
Terrance J. Bauer Mar. 1990 87 p
(AD-A225433) Avail: NTIS HC/MF A05 CSCL 09/3

The performance of a sensor blending scheme for two different band-width sensors is significantly improved when a Kalman filter is used to blend the outputs vice classical control methods. This Kalman filter signal blender is designed and implemented in a computer program developed for this thesis. Several tracking scenarios are simulated and analyzed. These scenarios are representative of the input expected into the sensors on a Space Based Laser. GRA

N91-12882# State Univ. of New York, Buffalo. Dept. of Chemistry.
LINEAR AND NONLINEAR OPTICAL PROPERTIES OF SMALL SILICON CLUSTERS
Tapio T. Rantala, Mark I. Stockman, Daniel A. Jelski, and Thomas F. George Aug. 1990 53 p
(Contract N00014-90-J-1193)
(AD-A225495; UBUFFALO/DC/90/TR-20) Avail: NTIS HC/MF A04 CSCL 09/1

Electronic contributions to the optical properties of small silicon clusters are examined. Geometries and the electronic structures of the clusters are established using the tight-binding model, and linear as well as nonlinear polarizabilities of conjecture for hyperpolarizabilities is shown to be violated in the frequency-degenerate case, which is of practical importance. The nonlinear polarizabilities are found to depend primarily on the symmetry of the cluster and prove to be high for the low symmetry clusters. Possible experiments and applications are discussed. GRA

N91-12883# Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
JOINT SERVICES ELECTRONICS PROGRAM Annual Progress Report No. 104, 1 Aug. 1989 - 31 Jul. 1990
Michael Tinkham 31 Jul. 1990 114 p
(Contract N00014-89-J-1023)
(AD-A225506) Avail: NTIS HC/MF A06 CSCL 09/1

An annual report of the Joint Services Electronics Program in solid state electronics, information electronics, control and optimization, and electromagnetic phenomena is presented. Results of the research to date are summarized and significant accomplishments are discussed. GRA

N91-12884# Wilson Greatbatch Ltd., Clarence, NY.
FEASIBILITY OF A SUPER HIGH ENERGY DENSITY BATTERY OF THE Li/Br/F3 ELECTROCHEMICAL SYSTEM Final Report, 15 Aug. 1989 - 14 May 1990
Christine A. Frysz, Michael F. Pyszczek, and Steven J. Ebel 16 Aug. 1990 32 p
(Contract N00014-89-C-0232)
(AD-A225508; WGL-R/D-90-073; WGL-MLR-90-07) Avail: NTIS HC/MF A03 CSCL 10/3

Feasibility studies on the practical aspects of developing a lithium/bromine trifluoride battery have been studied. Efforts directed toward identifying materials for porous electrode separators, glasses for insulated electrical feed-throughs, and metals for lid, case and current collector fabrication via electrochemical testing techniques have resulted in a list of materials suitable for these applications. Prototype cells utilizing a spirally wound electrode configuration have been constructed and discharged. The use of lithium salts as an electrolyte additive has been explored, and has shown a positive effect on discharge performance. Through the use of currently available technology, however, the lithium/bromine trifluoride couple has not delivered energy density comparable to other high energy density lithium systems. This investigation has revealed that practical Li/BrF3 cell development will require further extensive fundamental electrochemical research. GRA

N91-12885# North Carolina Univ., Raleigh. Dept. of Materials Science and Engineering.
RESEARCH AND DEVELOPMENT ON ADVANCED SILICON CARBIDE THIN FILM GROWTH TECHNIQUES AND FABRICATION OF HIGH POWER AND MICROWAVE FREQUENCY SILICON CARBIDE-BASED DEVICE STRUCTURES Semiannual Report, 1 Jan. - 30 Jun. 1990
Robert F. Davis, R. J. Trew, John W. Palmour, Larry Rowland, and Lisa Spellman Jul. 1990 67 p
(Contract N00014-88-K-0341)
(AD-A225883) Avail: NTIS HC/MF A04 CSCL 09/1

In this reporting period the RF operation of bipolar transistors fabricated from a (6H)-SiC have been theoretically modeled and the dc and RF performance of a MESFET fabricated in a-SiC by Cree Research investigated and improved from the standpoints of parasitic resistances and capacitances as well as device design and fabrication procedures. In addition IMPATT diode structures have been further developed, ohmic and Schottky contact materials selected and deposited and the design and construction of a new molecular beam epitaxy/atomic layer epitaxy (MBE/ALE) system virtually completed. GRA

N91-12886# California Univ., Irvine. Dept. of Physics.
EFFECT OF INTERCALATED LITHIUM ON THE ELECTRONIC BAND STRUCTURE OF INDIUM SELENIDE

1 Aug. 1990 22 p
(Contract N00014-88-K-0392)
(AD-A225933; TR-2) Avail: NTIS HC/MF A03 CSCL 09/1

The purpose of the project on Superionics supported by DARPA Contract No. N00014-88-K-0392 is to develop a physical understanding of the elements of a solid state battery consisting of a lithium anode, a lithium-doped borate glass separator and a lithium-intercalated InSe cathode. In this report a theoretical analysis based on a tight-binding model is presented for the electronic structure of both pure and lithium-intercalated InSe. An understanding of the electronic structure is necessary for an understanding of the electrical conductivity due to both electronic motion and lithium-ion motion. The conductivity is an important parameter for the performance of the solid state battery. GRA

N91-12887# Michigan Univ., Ann Arbor. Radiation Lab.
THEORETICAL AND EXPERIMENTAL STUDY OF MICROSTRIP DISCONTINUITIES IN MILLIMETER WAVE INTEGRATED CIRCUITS Final Report, 1 Jun. 1987 - 31 May 1990
Linda P. B. Katehi Jul. 1990 13 p
(Contract DAAL03-87-K-0088)
(AD-A225942; ARO-23836.17-EL) Avail: NTIS HC/MF A03 CSCL 09/1

This effort addresses the general problem of developing more accurate analytical methods to characterize open and shielded microstrip structures as used in millimeter-wave integrated circuits. Emphasis is placed on the open structure since past theoretical treatment of this problem is considered inadequate, particularly with regard to radiation losses. Consideration is also given to the shielded case which is more common in practical circuit design. GRA

N91-12888# Rutgers Univ., Piscataway, NJ. Coll. of Engineering.
MODELING FREQUENCY FLUCTUATIONS IN SURFACE CONTAMINATED CRYSTAL RESONATORS Final Report
Yook-Kong Yong 23 Jul. 1990 50 p
(Contract DAAL03-87-K-0107)
(AD-A226019; ARO-25224.8-EL) Avail: NTIS HC/MF A03 CSCL 09/1

Effects of adsorption and desorption of surface contaminant molecules on mean resonant frequency and frequency fluctuations are studied. A model based on mass-loading of contaminant molecules with adsorption and desorption rates is developed. Equations relating change in mean frequency and frequency fluctuations to adsorption and desorption rates are derived. Since the adsorption and desorption rates are functions of pressure and temperature, change in mean frequency and spectral density of frequency fluctuations are studied with respect to pressure and temperature. Calculations are performed for a 10 MHz and a 525 MHz thickness-shear resonator. Frequency-temperature and frequency-pressure curves are plotted for the 10 MHz resonator. The curves do not follow a cubic polynomial function and have a magnitude in the range of 10 ppm. The mean square of frequency fluctuations under multilayer contamination is significantly greater than that under monolayer contamination. The spectral density of frequency fluctuations at 1 Hz is quite constant in a wide range of temperatures (-50 to 100 C) when the values of heat of adsorption for the second and subsequent layers is close to that for the first layer. The magnitude of spectral density of frequency fluctuations is about -120 dBc (Hz2/Hz). The spectral density of frequency fluctuations is inversely proportional to the fourth power of the thickness if other parameters are held constant. GRA

N91-12889# Army Lab. Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.
LITHIUM TETRABORATE TRANSDUCER CUTS Technical Report, Dec. 1988 - Dec. 1989
John Kosinski, Arthur Ballato, and Theodore Lukaszek Mar. 1990 22 p
(AD-A226028; SLCET-TR-90-4) Avail: NTIS HC/MF A03 CSCL 09/1

Lithium tetraborate is a tetragonal material of considerable promise for frequency control and signal processing applications. It exhibits piezoelectric coupling values that fall between those of lithium niobate and quartz, but possesses orientations for which the temperature coefficient of frequency and delay time is zero for bulk and surface acoustic waves. In this report, we discuss the properties of two doubly rotated bulk wave resonator orientations having both first- and second-order temperature coefficients equal to zero. These are suitable for shear and compressional wave transducers in applications where very low temperature sensitivity is required simultaneously with moderately strong piezocoupling coefficients. GRA

N91-12890# California Univ., Los Angeles. Dept. of Electrical Sciences and Engineering.
COMPACT MILLIMETER-WAVE DEVICES: CHERENKOV CARM, VOLTAGE CARM AND HIGH HARMONIC GYROTRON Final Report, 1 Aug. 1986 - 30 Nov. 1989
Neville C. Luhmann, Jr. 30 Nov. 1989 38 p
(Grant AF-AFOSR-0199-86; AF Proj. 2301)
(AD-A226070; AFOSR-90-0880TR) Avail: NTIS HC/MF A03 CSCL 09/1

The dielectric loaded cyclotron autoresonance maser (CARN) experiments were extremely disappointing. Even with a high quality electron beam, the performance of the device did not improve. The analytical theory of Bragg reflectors was developed. The reflection is found by solving the coupled differential equations by the eigenvalue/eiginvector method. GRA

N91-12891# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Sciences.
STUDIES OF HETERO-EPITAXY OF GaAs FILMS ON Si SUBSTRATE FOR EFFECTIVE CONTROL OF DEFECT DENSITY AND INTERNAL STRESS Technical Progress Report, 15 Apr. 1989 - 14 Apr. 1990
Shyh Wang May 1990 14 p
(Grant AF-AFOSR-0174-88)
(AD-A226144; AFOSR-90-0871TR) Avail: NTIS HC/MF A03 CSCL 09/1

During the period April 1989 to 1990, we carried out experiments on studies of heteroepitaxial films grown on lattice-mismatched substrates in three main areas: (1) migration-enhanced (or modulated) MBE to promote 2-dimensional growth of heteroepitaxial films, (2) growth on patterned substrates to reduce thermal stress, and (3) study of GaAs/Si laser characteristics, especially polarization dependence and threshold current, to correlate with results from basic material studies in area 1 and 2. Recently we have started exploring new directions for hetero-epitaxy on lattice-mismatched substrates, and have done exploratory work on (4) growth on (111) plane of strained AlInAs/AlAs quantum well and (5) GaAs growth on Si/sapphire (SOI) substrate. In this report, we first summarize experimental results on work in groups 1, 2 and 3. This followed by a discussion of our exploratory work which will point the direction for our future research. GRA

N91-12892# Naval Ocean Systems Center, San Diego, CA.
ASSESSMENT OF LI/SOCI2 BATTERY TECHNOLOGY: RESERVE, THIN-CELL DESIGN, VOLUME 3 Final Report, Apr. 1987 - Jun. 1990
P. A. Mosier-Boss and S. Szpak Jun. 1990 242 p Sponsored by ONR, Arlington, VA
(AD-A226184; NOSC/TR-1154-Vol-3) Avail: NTIS HC/MF A11 CSCL 10/3

In choosing and developing a battery system, extensive research, i.e., computer modeling and electrochemistry experiments is required. The kinetics of chemical and electrochemical reactions determine the operational characteristics of a battery, including discharge rate capability and shelf storage life. This in turn affects power output. Battery design also affects battery output, i.e., distance between the bipolar plates, thickness of the electrodes and spacers, materials used, uniformity of electrolyte flow, etc. To maximize the performance of a battery system, therefore, one must do basic research ot identify the electrochemical and chemical

process occurring within the battery. Too often this has not been done with the expected results. With regards to Li/SOCl2 battery development program described in Volume 1 of TR 1154, this volume contains a compilation of technical papers and is a continuation of Volume 2 of TR 1154. These papers have appeared in referred journals and books. In addition, abstracts of presentations given at meetings and a table of contents for the previous two volumes of TR 1154 are included. This work was performed as part of the Naval Ocean Systems Center Independent Exploratory Development program and constitutes a portion of a program whose goal is to establish a technology base for high-discharge rate Li/SOCl2 batteries. GRA

N91-12893# Texas Univ., Austin. Microwave Lab.
MICROWAVE AND MILLIMETER-WAVE OSCILLATORS AND PLANAR POWER COMBINING STRUCTURES FOR QWITT AND GUNN DIODES
Amir Mortazawi, Dean Neikirk, and Tatsuo Itoh Aug. 1990 108 p
(Contracts DAAL03-88-K-0005; F49620-89-C-0044)
(AD-A226246; MICROWAVE-LAB-90-P-4; ARO-25045.44-EL)
Avail: NTIS HC/MF A06 CSCL 09/1

Quantum Well (QW) diode oscillators have recently been shown to have the potential to generate power in the millimeter (mm) and sub-mm wave region. The small signal microwave impedance of a modified QW device called the quantum well injection transmit time (QWITT) diode is measured and compared with theoretical predictions. Based on the small signal impedance of the device, several QWITT oscillators were designed and fabricated. The highest power ever reported for a QW diode oscillator was obtained at about 8 GHz. GRA

N91-12894# Arizona Univ., Tucson.
A QUANTUM-EFFICIENT SYSTEMATICS-FREE PHOTON-COUNTING OPTICAL IMAGING SYSTEM FOR LONG BASELINE INTERFEROMETRIC IMAGING OF FAINT DEEP SPACE OBJECTS Final Technical Report, Jul. 1987 - Sep. 1989
E. Keith Hege Jun. 1990 45 p
(Contract F30602-85-C-0313; ARPA Order 5976; AF Proj. D174)
(AD-A226336; RADC-TR-90-150) Avail: NTIS HC/MF A03 CSCL 09/1

A four state Proxitronic image intensifier with system digital video readout was developed for use as a high detective quantum efficiency photon counting imaging detector optimized for long baseline speckle interferometric imaging of deep space objects. Accurate noise bias calibration requires low geometric distortion image intensifiers as well as linear video readout to yield a stable, calibratable photon point spread function. The image intensifier optimization is not limited to video raster systems but is intended to produce techniques for implementation of a fast phosphor (X-3 response) image intensifier first stage with MAMA- or PAPA-type photon-coordinate readout systems. The objective is to demonstrate a prototype system for further evaluation of image intensifier capabilities in speckle imaging applications, and to demonstrate an observing system optimized for use in diffraction- and statistics-limited imaging at the lowest possible photon flux with the highest possible photon counting efficiency. GRA

N91-12895# Lawrence Livermore National Lab., CA.
PHOTOCONDUCTIVITY OF ACTIVATED CARBON FIBERS
K. Kuriyama and M. S. Dresselhaus (Massachusetts Inst. of Tech., Cambridge.) Aug. 1990 34 p
(Contract W-7405-eng-48)
(DE91-000814; UCRL-CR-104934) Avail: NTIS HC/MF A03

The photoconductivity is measured on a high-surface-area disordered carbon material, namely activated carbon fibers, to investigate their electronic properties. Measurements of decay time, recombination kinetics and temperature dependence of the photoconductivity generally reflect the electronic properties of a material. The material studied in this paper is a highly disordered carbon derived from a phenolic precursor, having a huge specific surface area of 1000 to 2000 sq m/g. Our preliminary thermopower measurements suggest that this carbon material is a p-type semiconductor with an amorphous-like microstructure. The intrinsic electrical conductivity, on the order of 20 S/cm at room temperature, increases with increasing temperature in the range 30 to 290 K. In contrast with the intrinsic conductivity, the photoconductivity in vacuum decreases with increasing temperature. The recombination kinetics changes from a monomolecular process at room temperature to a bimolecular process at low temperatures. The observed decay time of the photoconductivity is approximately 0.3 sec. The magnitude of the photoconductive signal was reduced by a factor of ten when the sample was exposed to air. The intrinsic carrier density and the activation energy for conduction are estimated to be approximately 10(exp 21)/cu cm and approximately 20 meV, respectively. The majority of the induced photocarriers and of the intrinsic carriers are trapped, resulting in the long decay time of the photoconductivity and the positive temperature dependence of the conductivity. DOE

N91-12896# Technische Univ., Darmstadt (Germany, F.R.). Fachbereich Physik.
PROJECT AND CALCULATION OF A HIGH RESOLUTION LOW VOLTAGE RASTER ELECTRON MICROSCOPE Ph.D. Thesis [ENTWURF UND BERECHNUNG EINES HOCHAUFLOESENDEN NIEDERSPANNUNGS-RASTER ELEKTRONENMIKROSKOPS]
Joachim Zach 1989 79 p In GERMAN
(ETN-90-98163) Avail: NTIS HC/MF A05

A raster electron microscope is developed whose resolution power is about a nanometer and which contains a multipole corrector and a special objective, the electrostatic detector objective lens for the efficient detection of the secondary electrons without perturbation of the primary beam. A new method for the calculation of corrected electrooptic systems was developed to examine the properties of these components. A structure with three electrodes whose potential was analytically calculated, was achieved to find a lens geometry. The measurement results agree with the calculated properties. ESA

N91-12897# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
EXPERIMENTAL AND THEORETICAL EXAMINATION OF FILED CONTROLLED THYRISTORS (FCTS) Ph.D. Thesis [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNG FELDGESTEURTER THYRISTOREN (FCT'S)]
Sen-Mao Liao 1990 207 p In GERMAN
(ETN-90-98178) Avail: NTIS HC/MF A10

The examination of the static and dynamic behavior of FCTs was carried out. The results showed that a narrow channel width specimen gives a low forward direct current resistance. A short review of FCTs mode of functioning was made. The design and the fabrication process for FCT samples was described. The central point was the examination of the possibility to connect, for surface gates, higher interlocking reinforcement with good electric properties, such as shorter switching times. ESA

N91-13345*# Duke Univ., Durham, NC. Dept. of Electrical Engineering.
DESIGN OF QMF (QUADRATURE MIRROR FILTER) IN SPATIAL DOMAIN AND EDGE ENCODING
Paul P. Wang *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 119-122 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N91-12898 Virginia Polytechnic Inst. and State Univ., Blacksburg.
INSTABILITIES OF A COMPRESSIBLE MIXING LAYER Ph.D. Thesis
Jeun-Len Wu 1989 305 p
Avail: Univ. Microfilms Order No. DA9013526

Instability waves in a free shear layer formed by two parallel compressible streams are analyzed using the linear spatial stability theory. The effects of viscosity, Mach number, the velocity, and temperature ratios on the growth rate are determined. Increasing the temperature ratio produces a strong stabilizing effect on the growth of the mixing flow; this stabilization does not, however, persist at higher Mach numbers. Whereas the maximum growth rate of the incompressible mixing layer varies linearly with the velocity ratio, the maximum growth rate of the compressible mixing flow varies nonlinearly with the velocity ratio. The convective Mach number is found to be the appropriate parameter for correlating the compressibility effects on the spreading rate of the mixing layer. Linear subharmonic instabilities of a compressible mixing layer are analyzed by using Floquet theory. The basic state is obtained by the linear superposition of a steady mean flow and the neutral primary wave of that mean flow. The growth rates of two-dimensional subharmonic instabilities are shown to increase with increasing amplitude of the periodicity but decrease with increasing convective Mach number. For subsonic convective Mach numbers, the presence of the periodicity enhances the growth rates of three-dimensional subharmonic waves over a wide range of spanwise wavenumber. However, when the convective Mach number is greater than one, the interaction between the subharmonic wave and the primary wave marginally increases the maximum growth rate of the subharmonic, which dramatically increases the range of amplified spanwise wave numbers. Fourth-order compact finite-difference codes are developed for solving the compressible boundary-layer equations and investigating their primary and subharmonic instabilities. Dissert. Abstr.

N91-12899# Japan Atomic Energy Research Inst., Tokai.
DEVELOPMENTAL ASSESSMENT OF RELAP5/MOD3 CODE AGAINST ROSA-IV/TPTF HORIZONTAL TWO-PHASE FLOW EXPERIMENTS
Yutaka Kukita, Hideaki Asaka, Yoshinari Anoda, Misako Ishiguro, Kanji Tasaka, Yuichi Mimura, and Toshiyuki Nemoto Mar. 1990 25 p
(DE90-513748; JAERI-M-90-053) Avail: NTIS (US Sales Only) HC/MF A03

A developmental version of the RELAP5/Mod3 code (as of June 1989) was assessed for accuracy using experimental data taken for high-pressure (7MPa) steam-water two-phase flow in a large-diameter (0.18 m) horizontal-pipe test section of the ROSA-IV Two-Phase Flow Test Facility (TPTF). The agreement between the measured and calculated test section void fractions was much better than that for the previous generation of RELAP5 (MOD2). The improvement was achieved primarily due to the code changes with respect to the flow stratification criterion and interfacial-drag calculation scheme. DOE

N91-12900# Japan Atomic Energy Research Inst., Tokyo. Dept. of High Temperature Engineering.
AUTOMATED FINDER FOR THE CRITICAL CONDITION ON THE LINEAR STABILITY OF FLUID MOTIONS
Kaoru Fujimura Mar. 1990 31 p
(DE90-513761; JAERI-M-90-057) Avail: NTIS (US Sales Only) HC A03

An automated finder routine for the critical condition on the linear stability of fluid motions is proposed. The Newton-Raphson method was utilized for an iteration to solve nonlinear eigenvalue problems appeared in the analysis. The routine was applied to linear stability problem of a free convection between vertical parallel plates with different non-uniform temperatures as well as a plane Poiseuille flow. An efficiency of the finder routine is demonstrated for several parameter sets, numerically. DOE

N91-12901 ESDU International Ltd., London (England).
BOILING INSIDE TUBES: POST DRY-OUT HEAT TRANSFER IN VERTICAL TUBES Abstract Only
Apr. 1990 35 p
(ESDU-90001; ISBN-0-85679-716-2; ISSN-0141-402X) Avail: ESDU

Methods are presented for calculating the heat transfer coefficient in the post dry-out region (that is when the critical heat flux is exceeded and the liquid no longer wets the tube walls) for upward flow in vertical tubes. The methods are restricted to high quality flow (that is when a large proportion of the fluid is vapor) and a test for the applicability of the methods is included. Two different methods are given, one for steam/water flows and one for other fluids. Detailed step-by-step calculation procedures are set out in both cases for the determination of either the wall temperature when the tube is subjected to know heat flux (for example, when electrically heated) or the heat flux when the tube is heated to a known temperature, and all four cases are illustrated by worked example calculations. The accuracy of the methods is discussed and for steam/water is stated to be better than 20 percent by comparison of predictions with some 2000 experimental values for which the ranges of the variables are also given. Results in the case of the method for other fluids were about the same, but were tested against 350 experimental points for four fluids. The ranges of the experimental data are again included. A method of taking account of radiation is also provided. ESDU

N91-12902 Princeton Univ., NJ.
SOLUTION OF THE EULER EQUATIONS IN MULTIBODY FLOW FIELDS USING THE OVERLAPPING-MESH METHOD Ph.D. Thesis
Takeshi Sakata 1990 116 p
Avail: Univ. Microfilms Order No. DA9027582

A simple and easily implementable overlapping-mesh method is introduced. This method, consisting of independently generated component grids overlaid on one another and a interpolation scheme for inter-grid communications, requires only a hierarchical grid structure and a no-touch condition for a component grid to the other bodies. An efficient method to set up the overlaps is also developed. Combined with a finite volume, semi-discrete, explicit time-stepping Euler flow solver, this method was applied to two-dimensional two-body flow problems in subsonic and transonic range. In the cases of two parallel NADA0012 airfoils, the symmetric, transonic nature of the flow field is well realized despite the asymmetric mesh arrangement. A strong shock wave that passes through the mesh interfaces as a result of the interaction effect is also well captured, mainly due to the compactness of the bilinear interpolation scheme. The application to an airfoil with a flap poses a severe geometric problem in mesh generation, but minor modifications to the generators yield an excellent agreement with the exact solution. As an alternative approach, a hybrid-mesh method is also introduced. The use of triangular mesh eliminates the ambiguity of interpolations, but it turns out that dissipation requires careful treatment at the mesh interfaces. Preliminary results presented show the areas where extensive future work should be directed. The simplicity and flexibility of the overlapping-mesh method promises further applications to three-dimensional problems of complex geometries. Dissert. Abstr.

N91-12903# Universidad Politecnica de Madrid (Spain). Escuela Technica Superior De Ingenieros Aeronauticos.
PROCEEDINGS OF THE NATO ADVANCE RESEARCH WORKSHOP. THE GLOBAL GEOMETRY OF TURBULENCE: IMPACT OF NONLINEAR DYNAMICS, ABSTRACTS AND TECHNICAL PROGRAM
14 Jul. 1990 37 p Workshop held in Rota (Cadiz) Spain, 8-14 Jul. 1990
(Contract DAJA45-90-M-0117)
(AD-A225448; R/D-6417-AN-02) Avail: NTIS HC/MF A03 CSCL 20/4

Session topics include: Amplitude equations; Shear flow; Bifurcations and transitions to chaos; Direct numerical simulation; Dynamic systems and turbulence; Vorticity dynamics. GRA

N91-12904# R and D Associates, Albuquerque, NM.
TRIMIX: A VORTICITY-STREAM FUNCTION APPROACH TO CALCULATING THREE-DIMENSIONAL MIXING FOR VISCOUS, PARABOLIC FLOWS Final Report, 1 Mar. 1988 - 31 Dec. 1989
Peter G. Crowell Jul. 1990 65 p
(Contract F29601-87-C-0005)
(AD-A225817; WL-TR-90-19) Avail: NTIS HC/MF A04 CSCL 20/4

A 3D Computer code (TRIMIX) was developed to predict the influence of axial vorticity and diffusional velocity model on the rate of mixing between a primary flow and an injected secondary flow. Computational results are presented for the gain and iodine dissociation in an oxygen/iodine laser and compared with results obtained using the 1D premixed approximation. The premixed model significantly underpredicts laser performance; and the binary diffusion model and the zero vorticity approximation both lead to large error in the predicted gain. GRA

N91-12905# Texas Univ., Austin. Dept. of Mechanical Engineering.
THE PHYSICS OF TURBULENT BOUNDARY LAYER STRUCTURES AND EFFECTS DUE TO MANIPULATION Final Report, 1 Aug. 1986 - 31 Jul. 1989
Chcon L. Gan and David G. Bofard 14 Jun. 1990 166 p
(Contract N00014-86-K-0657)
(AD-A225834; TTCRL-90-1) Avail: NTIS HC/MF A08 CSCL 20/4

A summary of work conducted on a scanning laser Doppler velocimeter (LDV) system, three dimensional mapping of burst and sweeps, and large eddy break up (LEBU) effects on ejections and bursts is presented. This followed by an in depth report on the three dimensional mapping of the burst structure. This study was conducted using an X-film probe to detect the burst and a three-component LDV to map the velocity field. Conditional sampling analysis showed a streamwise vortical structure with the downstream end inclined up from the wall. GRA

N91-12906# Illinois Inst. of Tech., Chicago. Fluid Dynamics Research Center.
COUPLED EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF INSTABILITY, CHAOS AND TURBULENCE IN AN AXISYMMETRIC JET FLOW Final Technical Report, Apr. 1986 - Oct. 1989
Thomas C. Corke, Hassan M. Nagib, and Simon Rosenblatt Jul. 1990 396 p
(Grant AF-AFOSR-0165-86; AF Proj. 2307)
(AD-A225971; AFOSR-90-0897TR) Avail: NTIS HC/MF A17 CSCL 20/4

This work focused on instability, routes to chaos, and transition to turbulence in an axisymmetric jet. The research focused on three basic tasks. The first involved the search for evidence of low dimensional strange attractors in a naturally excited condition. The theoretical analog was the construction of low-dimensional model equations for this flow. The second involved 3-D (non-axisymmetric) periodic forcing of the jet to lead to the enhanced growth of 3-D modes. This was to focus on natural resonant mechanisms involving natural instability modes of the shear layer and jet core. The theoretical analysis for this part was to predict the conditions for the most resonant interactions, which would maximize our ability to control the jet outcome. The third task was to integrate the previous tasks to exploit important mode interactions which lead to strong nonlinear regimes and/or random or chaotic states. In this phase, we accomplished this through intrinsic forcing of the jet by enhanced feedback. The results of the work have covered all these tasks, and yielded many new fundamental results basic to dynamical systems with feedback. GRA

N91-12907# Clemson Univ., SC. Dept. of Mechanical Engineering.
EXPERIMENTAL INVESTIGATION OF TURBULENT PRANDTL NUMBER AND REYNOLDS ANALOGY IN TRANSITIONAL AND POST-TRANSITIONAL BOUNDARY LAYERS Annual Progress Report, 24 Jul. 1989 - 31 Jul. 1990
Wang Ting 31 Jul. 1990 12 p
(Contract N00014-89-J-3105)
(AD-A226058) Avail: NTIS HC/MF A03 CSCL 20/4

The major progress during the past year has been in these areas: (1) Calibration and modification of the heated test wall, (2) Development of data acquisition and reduction programs for fluid mechanics and heat transfer measurements, (3) Measurements of the baseline experiment on a flat surface, and (4) Literature search, design and fabrication of a three-wire probe for measuring Reynolds heat flux in a transitional boundary layer. The preliminary results of mean flow and temperature from the baseline experiment indicated that the test facility and apparatus are well controlled and adequate for conducting studies of natural transition boundary layers. The distribution of skin-friction coefficient and Stanton number has indicated a breakdown of Reynolds analogy in the transitional flow and was not recovered even in the fully turbulent flow regime in the present wind tunnel test section. GRA

N91-12908# Pennsylvania State Univ., State College. Applied Research Lab.
A FLUORESCENCE TECHNIQUE FOR MEASUREMENT OF SLOT INJECTED FLUID CONCENTRATION PROFILES IN A TURBULENT BOUNDARY LAYER
T. A. Brungart and H. L. Petrie 27 Aug. 1990 39 p Sponsored by Dept. of the Navy
(AD-A226122; PSU/ARL-TM-90-197) Avail: NTIS HC/MF A03 CSCL 20/4

A technique for measuring near instantaneous concentration profiles of a fluid injected through a narrow inclined slot at the wall into a high unit Reynolds number flat plate turbulent boundary layer is discussed. The concentration profiles are determined by measuring the light intensity emitted from a fluorescent dye, premixed into the injectant flow, as the injectant convects through an excitation laser beam. The fluorescence intensity is quantified by an electronically shuttered single stage microchannel plate image intensifier coupled to a linear photodiode array. This instrumentation provided the high spatial and temporal resolution required for these boundary layer concentration profile measurements. The laser induced fluorescence technique is being used to study the diffusion of injected polymer solutions away from the near wall region of the boundary layer where these solutions are effective in reducing drag. The diffusion of slot injected water has also been examined and the present results are in excellent agreement with previous studies. GRA

N91-12909# David Taylor Research Center, Bethesda, MD. Dept. of Propulsion and Auxiliary Systems.
A DIFFERENTIAL TURBOMACHINERY EQUATION WITH VISCOUS CORRECTION Thesis - Maryland Univ. Final Report, 1989 - 1990
Herman B. Urbach Jul. 1990 28 p
(AD-A226183; DTRC/PAS-90-45) Avail: NTIS HC/MF A03 CSCL 20/4

A differential turbomachinery equation describing the energy transfer between a fluid and any body moving in that fluid was derived. The derivation is based upon the Coriolis form of the Navier-Stokes Equations. A differential equation for the total relative

rothalpy was also obtained. The equalities contain a rigorous viscous correction for the total enthalpy and rothalpy. The differential equation defines the substantial derivative of the total enthalpy at any point in a fluid. This substantial derivative represents the energy transfer rate into or out of the fluid at the point. In order to obtain the total enthalpy transfer between the fluid and the body, it is necessary to integrate over the entire domain. For ideal flow regimes, the integration domain may be restricted entirely within the rotor. For real fluids, viscous coupling requires that regions outside the blade area be considered. One integration of the differential equations, a form of the Euler Turbomachinery Equation with viscous correction is derived. The resultant form contains two distinct work rate terms for the axial and radial components of the flow. The fact that integration yields a result which approximates the classic Euler Turbomachinery Equation constitutes confirmation of the derivation. An application of the equation to an ideal infinite linear cylinder with bound vorticity was developed. The cylinder was made to act like a turbine blade performing work by lifting an ideal airframe against gravity. The integration yielded the expected known result. GRA

N91-12910# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.

NAVIER-STOKES SIMULATION OF BOUNDARY-LAYER TRANSITION Final Report, 14 Apr. 1987 - 14 Oct. 1989

Helen L. Reed May 1990 40 p

(Grant AF-AFOSR-0237-87; AF Proj. 2307)

(AD-A226351; AFOSR-90-0886TR) Avail: NTIS HC/MF A03 CSCL 20/4

This report describes the successful efforts to computationally model the receptivity of the laminar boundary layer on a semi-infinite flat plat with an elliptic leading edge by a spatial simulation. The compressible flow is simulated by solving the governing full Navier-Stokes equations in general curvilinear coordinates by a finite difference method. First, the steady basic-state solution is obtained in a transient approach using spatially varying time steps. Then, a small-amplitude acoustic disturbances of the freestream velocity are applied as unsteady boundary conditions, and the governing equations are solved time-accurately to evaluate the spatial and temporal developments of the perturbation leading to instability waves (Tollmien-Schlichting waves) in the boundary layer. The effect of leading type radius on receptivity is determined. GRA

N91-12911# Sandia National Labs., Livermore, CA. Applied Mechanics Dept.

COMPRESSIBLE FLOW OF A MULTIPHASE FLUID BETWEEN TWO VESSELS. PART 1: IDEAL CARRIER GAS

Donald R. Chenoweth and Samuel Paolucci (Notre Dame Univ., IN.) Jun. 1990 47 p

(Contract DE-AC04-76DR-00789)

(DE91-000490; SAND-90-8486-Pt-1) Avail: NTIS HC/MF A03

The transfer of a multiphase fluid from a high pressure vessel to one initially at lower pressure is investigated. The fluid is composed of two phases which do not undergo any change. The phases consist of an ideal gas, and solid particles (or liquid droplets) having constant density. The mixture is assumed to be stagnant and always perfectly mixed as well as at thermal equilibrium in each constant volume vessel. The fluid also remains homogeneous and at equilibrium while flowing between vessels. The transport properties of the mixture are taken to be zero. One important finding is that the expanding mixture or pseudo-fluid behaves similar to a polytropic Abel-Noble gas. The mixture thermodynamic properties, the end state in each vessel at pressure equilibrium, the critical parameters, and time dependent results are given for the adiabatic and isothermal limiting cases. The results include both initially sonic and initially subsonic transfer. No mathematical restriction is placed on the particle concentration, although some limiting results are given for small particle volume fraction. The mass transferred at adiabatic pressure equilibrium can be significantly less than that when thermal equilibrium is also reached. Furthermore, the adiabatic pressure equilibrium level may not be the same as that obtained at thermal equilibrium, even when all initial temperatures are the same. Finally, it is shown that the transfer times can be very slow compared to those of a pure gas due to the large reduction possible in the mixture sound speed. DOE

N91-12912# Pittsburgh Energy Technology Center, PA.

ON THE VISCOSITY OF A MIXTURE OF PARTICULATE SOLIDS AND A FLUID CONTINUUM

M. Massoudi, J. M. Ekmann, and K. R. Rajagopal (Pittsburgh Univ., PA.) Sep. 1990 46 p Presented at the 26th Annual Meeting of the Society of Engineering Science, Ann Arbor, MI, 18-20 Sep. 1989

(DE91-000940; DOE/PETC/TR-90/8) Avail: NTIS HC/MF A03

In this work, the theory of interacting continua is used to formulate the governing equations of motion for each component and the mixture (a granular material and Newtonian fluid) as a whole. The fluid is assumed to be an incompressible viscous fluid and solid particles are treated as granular materials. Appropriate constitutive relations for stresses are proposed. Based on these, the stress tensor for the mixture is obtained, and in some ideal experiment where the velocities of the two phases are equal, a relationship among the viscosities of the two components and the viscosity of mixture exists. Based on these observations, simple experiments can be devised to obtain the viscosity of the solid particles. In Section 1, the importance of multicomponent flows is discussed. Section 2 provides a survey of literature on the stress tensors in two-phase flows. In Section 3, the basics of the theory of interacting continua are discussed and equations of motion for the mixture are derived. In the final section, a few experiments are suggested that would help in measuring the material properties of the mixture. DOE

N91-12913*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THE EFFECT OF COATINGS AND LINERS ON HEAT TRANSFER IN A DRY SHAFT-BUSH TRIBOSYSTEM

Mihir K. Ghosh and David E. Brewe (Army Aviation Systems Command, Cleveland, OH.) Aug. 1990 22 p Original contains color illustrations

(DA Proj. 1L1-61102-AH-45)

(NASA-TM-102513; E-5316; NAS 1.15:102513; AVSCOM-TR-90-C-006) Avail: NTIS HC/MF A03; 12 functional color pages CSCL 20D

The temperatures due to frictional heating within a solid lubricated or coated journal bearing were analyzed by using a finite element method. A solid model of the shaft-bush tribocontact was generated with an eight-node, three-dimensional, first-order isoparametric heat-transfer element and the Patran solid modeler software. The Patmar (Patran-Marc) translator was used to help develop the Marc-based finite element program for the system; this software was used on the Cray X-MP supercomputer to perform a finite element analysis of the contact. The analysis was performed for various liner materials, for thin, hard, wear-resistant coated bearings, and for different geometries and thermal cooling boundary conditions. The analyses indicated that thermal conductivity of the liner or coating material is the most vital thermal parameter that controls the interface temperature. In addition to design variations, the proximity of the cooling source to the heat-flux-generating interface is critically important to the temperature control in the system. Author

N91-12914# Ballistic Research Labs., Aberdeen Proving Ground, MD.

FLOW VISUALIZATION IN A PARTICLE LADEN JET FLOW Final Report, Jan. - May 1990

Csaba K. Zoltani, Ali F. Bicen, and Monte W. Coleman Aug. 1990 26 p

(DA Proj. 1L1-61102-AH-43)

(AD-A226432; BRL-TR-3134) Avail: NTIS HC/MF A03 CSCL 20/4

The results of a flow visualization study of the behavior of an unconfined, steady, fully turbulent, two phase jet of diameter 12.7 mm at the exit with velocities up to 25 m/s and containing particles

with a mass density of loading up to 5 percent are described. The significant result is the demonstration of fan spreading, whereby some of the particulates carried by the jet take paths outside of the expected envelope of an equivalent single-phase jet. Measurements of the path angles and a new theory to explain the reason for fan spreading is reported. GRA

N91-12915# Duisburg Univ. (Germany, F.R.). Fachbereich Maschinenbau.
CALCULATION OF THE FLOW IN THE CORRECTED BOUNDARY LAYER OF AXIAL FLOW COMPRESSOR STATORS Ph.D. Thesis [BERECHNUNG DER STROEMUNG IN RANDZONENKORRIGIERTEN AXIALVERDICHTER-LEITRAEDERN]
Manfred Janssen 1989 171 p In GERMAN
(ETN-90-98191) Avail: NTIS HC/MF A08

A calculation model allowing real flow calculations for stationary blade row is presented. A partial differential equation system for the mathematical description of the thermofluid dynamical parameter was needed as a basis. This equation system was formulated in cartesian coordinates. The important influence of friction and turbulence is considered for the determination of losses. The transformed partial differential equations were approached in difference equations. The solution algorithm developed for the numerical process of the flow calculation results for the examined blade configurations showed that a precise coverage of the loss regions is necessary to obtain reliable data for boundary layer correction. ESA

N91-12916# Dortmund Univ. (Germany, F.R.). Fachbereich Chemietechnik.
EXAMINATION OF A TURBULENCE STRUCTURE IN A PLANE MIXING LAYER AND BEHIND A CHANNEL ENLARGEMENT FOR THE FLOW OF TWO NON NEWTONIAN FLUIDS Ph.D. Thesis [UNTERSUCHUNG DER TURBULENZSTRUKTUR IN EINER EBENEN MISCHUNGSSCHICHT UND HINTER EINER KANALERWEITERUNG BEI DER STROEMUNG ZWEIER NICHT-NEWTONSCHER FLUESSIGKEITEN]
Siegfried Riediger 1989 89 p In GERMAN
(ETN-90-98193) Avail: NTIS HC/MF A05

The effects of the non Newtonian behavior of a viscoelastic polyacrylamide solution and of a 900 ppm solution of cationic tenside (C14 TaSal) on the plane mixing layer and the flow behind a discontinuous cross sectional enlargement were examined. Besides the temporary description of the flow field, the emphasis was put on the examination of the great coherent structures which originate in such shearing layers. The measures of the coherent structures in the plane mixing layer showed that the changes in the flow field are not to be explained by the high shear viscosity. In this case, the mixing layer should yield similar structures as water. The importance and the occurrence frequency of coherent structures are to be examined in comparison with the Newtonian fluids. ESA

N91-12516# Nippon Electric Co. Ltd., Yokohama (Japan). C/C Information Technology Research Labs.
A TWO- AND THREE-DIMENSIONAL FLUID FLOW ANALYSIS SYSTEM USING A FAST LINEAR SYSTEM SOLVER
Yukinori Akiba, Shun Doi, Ken Hayami, and Seiji Ishihara (Nippon Electric Co. Ltd., Tokyo, Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 19-25 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12520# National Aerospace Lab., Tokyo (Japan).
AN ASSESSMENT OF TURBULENCE MODELS IN COMPRESSIBLE VISCOUS FLOW ANALYSIS
Yuichi Matsuo (Tokyo Univ., Japan) and Shigeru Saito *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 45-51 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12521# Kyoto Univ. (Japan).
NUMERICAL ANALYSIS OF SUPERSONIC GAS-PARTICLE TWO-PHASE FLOWS AROUND A SPHERE
Ryuji Ishii, Yoshikuni Umeda, and Masatoshi Yuhi (Mazda K. K., Japan) *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 53-57 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12527# Nagoya Univ. (Japan).
NUMERICAL SIMULATION OF A SHOCK WAVE PROPAGATION IN THE SOLID PARTICLE LAYER
Manabu Hishida and Koichi Hayashi *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 87-91 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12530# National Aerospace Lab., Kakuda (Japan).
NUMERICAL TREATMENT OF LAMINAR FLOW IN CURVED RECTANGULAR CHANNELS
Hitoshi Yamada, Hiroshi Ishigaki, and Munekazu Mochizuki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 105-109 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12531# National Aerospace Lab., Kakuda (Japan).
FLOW AND HEAT TRANSFER IN CURVED PIPE
Shuichi Ueda, Hiroshi Ishigaki, and Munekazu Mochizuki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 111-115 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12532# National Aerospace Lab., Kakuda (Japan).
NUMERICAL ANALYSIS OF HEAT TRANSFER IN A PIPE ROTATING AROUND A PERPENDICULAR AXIS
Hiroshi Tamura, Hiroshi Ishigaki, and Munekazu Mochizuki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 117-121 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12533# National Aerospace Lab., Kakuda (Japan).
NUMERICAL SIMULATION OF FLOW BETWEEN CONCENTRIC ROTATING CYLINDERS
Munekazu Mochizuki and Hiroshi Ishigaki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 123-127 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12536# National Aerospace Lab., Tokyo (Japan).
A NUMERICAL ANALYSIS OF THE FLOW IN A CASCADE WITH TIP CLEARANCE
Toshinori Watanabe, Isao Kanazawa (National Space Development Agency, Tokyo, Japan), Osamu Nozaki, and Atsuhiro Tamura *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 141-146 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12538# Tohoku Univ., Sendai (Japan). Dept. of Mechanical Engineering.
NUMERICAL SIMULATIONS OF TRANSONIC CASCADE FLOW AND THEIR VISUALIZATIONS
Satoru Yamamoto and Hisaaki Daiguji *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics

1989 p 155-160 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12539# Kyushu Univ., Fukuoka (Japan). Dept. of Mechanical Engineering for Power.
A ZONAL APPROACH FOR SOLUTIONS TO THE COMPRESSIBLE NAVIER-STOKES EQUATIONS USING A TVD FINITE VOLUME METHOD
Masato Furukawa, Masao Yamasaki, and Masahiro Inoue *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 165-170 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12541# Osaka Univ. (Japan). Dept. of Aeronautical Engineering.
TOWARD THE AUTOMATIC FLOW SOLVER
Kazuhiro Nakahashi *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 177-183 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12546# Ship Research Inst., Tokyo (Japan).
USE OF SPLINE FUNCTIONS IN CFD
Yoshiaki Kodama *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 209-213 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12549# Kawasaki Heavy Industries Ltd., Kagamihara (Japan).
THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING. 7: A SIMPLE ANALYSIS METHOD OF SEPARATING FLOWS
Takashi Uchida and Eiji Shima *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 225-229 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12557# National Aerospace Lab., Tokyo (Japan).
ON THE NUMERICAL SIMULATIONS OF FLOW AROUND A BODY OF COMPLEX CONFIGURATIONS
Satoru Ogawa, Yasuhiro Wada, Tomiko Ishiguro, and Yoko Takakura *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 279-284 In JAPANESE; ENGLISH summary Prepared in cooperation with Fujitsu Ltd., Tokyo, Japan (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12558# National Aerospace Lab., Tokyo (Japan).
VERIFICATION OF NUMERICAL SIMULATION CODES FOR HYPERSONIC VISCOUS FLOW AROUND A SPACE PLANE
Yukimitsu Yamamoto, Haruhiko Arakawa, and Ryuji Yoshida (Mitsubishi Heavy-Industries Ltd., Tokyo, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 285-293 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12560# Shimizu Corp. (Japan). Dept. of Civil Engineering.
STUDY OF ACCURACY AND PERFORMANCE OF MODIFIED EULER SCHEME WITH FINITE ELEMENT METHOD ON FLOW PROBLEM
Wako Takanashi *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 303-306 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12562# National Aerospace Lab., Tokyo (Japan).
FINITE ELEMENT SOLUTION OF NAVIER-STOKES FLOW AROUND AEROFOILS: ACTIVE USE OF BLOCK TRIDIAGONAL MATRIX
Masashi Shigemi *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 313-320 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12597# National Aerospace Lab., Kakuda (Japan).
NUMERICAL ANALYSIS OF THE FLOW IN ROTATING STRAIGHT PIPE
Hiroshi Ishigaki and Munekazu Mochizuki *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 37-42 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12598# Tsukuba Univ. (Japan).
THE ACCURACY OF DIRECT NUMERICAL SIMULATION OF WALL TURBULENT FLOW AND THE NUMERICAL PREDICTION ON THE EFFECT OF DRAG REDUCING DEVICES
Tatsuya Ohgishi, Shunichi Tsuge, and Satoru Ogawa (National Aerospace Lab., Tokyo, Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 43-48 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12601# Nissan Motor Co. Ltd., Tokyo (Japan).
VISUALIZATION OF THE COMPUTED UNSTEADY FLOW IN THREE DIMENSIONS
Katsuro Fujitani and Ryutaro Himeno *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 61-65 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12603# Tohoku Univ., Sendai (Japan). Dept. of Mechanical Engineering.
AN IMPLICIT TIME-MARCHING METHOD FOR THE THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS OF CONTRAVARIANT VELOCITY COMPONENTS
Hisaaki Daiguji and Satoru Yamamoto *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 77-83 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12604# Osaka Univ. (Japan). Dept. of Aeronautical Engineering.
COMPUTATIONS OF THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS BY USING A PRISMATIC MESH
Kazuhiro Nakahashi *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 85-91 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12605# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
AN IMPLICIT SCHEME FOR UNSTEADY COMPRESSIBLE NAVIER-STOKES EQUATIONS
Kenichi Matsuno *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 93-96 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12607# National Aerospace Lab., Tokyo (Japan).
A COMPARATIVE STUDY ON TV-STABLE SCHEMES
Takayuki Aki *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 103-112

In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12608# National Aerospace Lab., Tokyo (Japan).
A NEW CLASS OF TVD SCHEMES AND WALL BOUNDARY CONDITION
Yasuhiro Wada and Kiyoshi Kumagai (Tokyo Noko Univ., Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 113-120 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12609# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
ON A NEW DIFFERENCE SCHEME-ATVD2
Satoru Ogawa, Tomiko Ishiguro, Yasuhiro Wada, and Yoko Takakura (Fujitsu Ltd., Tokyo, Japan) *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 121-125 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12610# Kawasaki Heavy Industries Ltd., Kobe (Japan).
THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING Report No. 6
Takuji Kishimoto and Takashi Uchida *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 127-132 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12614# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
UPWIND DIFFERENCING FOR VISCOUS FLOW COMPUTATIONS
Kozo Fujii, Susumu Takanashi, and Kisa Matsushima (Fujitsu Ltd., Tokyo, Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 159-162 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12619# Kyoto Univ. (Japan). Dept. of Aeronautics.
NUMERICAL ANALYSIS OF GAS-PARTICLE TWO-PHASE FLOWS
Ryuji Ishii, Yoshikuni Umeda, and Masatoshi Uhi *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 187-192 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12620# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
INTERACTION BETWEEN A SPHERICAL JET AND A FLOW
Takuya Matsuda, Yuzo Fujimoto, Eiji Shima, and Keisuke Sawada (Kawasaki Heavy Industries Ltd., Kobe, Japan) *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 193-198 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12621# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
NUMERICAL ANALYSIS OF HIGH VELOCITY FLOW FIELD AROUND THE BLUFF BODY
Yukinori Sato, Hidemi Toh, Yasunori Ando, and Masafumi Kawai *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 199-204 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-13310*# North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Mechanical Engineering.
TURBULENCE MODELING FOR HIGH SPEED COMPRESSIBLE FLOWS
Suresh Chandra *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 39-42 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

N91-13312*# Valparaiso Univ., IN. Dept. of Mechanical Engineering.
AN INVESTIGATION OF DESIGN OPTIMIZATION USING A 2-D VISCOUS FLOW CODE WITH MULTIGRID
Michael L. Doria *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 46-47 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

N91-13313*# State Univ. of New York, Buffalo. Dept. of Mechanical and Aerospace Engineering.
HIGH SPEED TURBULENT REACTING FLOWS: DNS AND LES
Peyman Givi *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 48-49 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

N91-13337*# City Univ. of New York, NY. Dept. of Mechanical Engineering.
SIMULATION OF ROTATION EFFECT IN TURBULENCE DISSIPATION RATE EQUATION Abstract Only
Rishi S. Raj *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 100 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

N91-13341*# Florida Inst. of Tech., Melbourne. Dept. of Mechanical and Aerospace Engineering.
COMPUTATIONAL ANALYSIS OF FLOW IN 3D PROPULSIVE TRANSITION DUCTS
Paavo Sepri *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 110-112 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N91-12917# Institut Franco-Allemand de Recherches, Saint-Louis (France).
MINIATURE LASER DOPPLER ANEMOMETER WITH LASER DIODE [ANEMOMETRE LASER A EFFET DOPPLER MINIATURISE A DIODE LASER]
S. Damp and H.-J. Pfeiffer 19 Aug. 1988 17 p In FRENCH Presented at 2nd Congres-Exposition de Metrologie Universelle, Rheim-Main-Halle, Wiesbaden, Fed. Republic of Germany, 27-29 Sep. 1988; and at 26th Colloque d'Aerodynamique Appliquee, Toulouse, France, 23-25 Oct. 1989 Original language document was announced as N90-16232
(ISL-CO-224/88; ETN-90-98024) Avail: NTIS HC/MF A03

A reduced model of a laser Doppler anemometer is proposed.

The aim is to develop an easily manipulated system for industrial applications. An 11 x 4 x 4 cm system is described. It contains electronic circuits ensuring the laser diode operation, a pre-amplifier and an amplifier. The system can be manufactured by using low cost optical components. The prototype was tested and the results are discussed. ESA

N91-12918# Army Cold Regions Research and Engineering Lab., Hanover, NH.
EVALUATION OF PVDF PIEZOPOLYMER FOR USE AS A SHOCK GAUGE
Piyush K. Dutta and John Kalafut Jun. 1990 16 p
(AD-A225955; CRREL-SR-90-23) Avail: NTIS HC/MF A03
CSCL 14/2

Polarized polyvinylidene fluoride film (PVDF) is a unique piezoelectric material with a very high sensitivity to shock pressure. It is also highly pliable. A large number of shock gauges were fabricated using this material; they were then calibrated and evaluated in the Split Hopkinson Pressure Bar Apparatus. Shock waves of defined geometry were passed through these test gauges and their responses were measured. Application of these gauges is foreseen in ground shock measurements where stress perturbations, because of gauge inclusion in the media, have to be minimized. This report discusses the development, construction, and evaluation of these gauges. GRA

N91-12919# JBS Technologies, Inc., Thousand Oaks, CA.
VERSATILE HIGH PERFORMANCE HOLOGRAPHIC OPTICAL COATINGS
Jeffrey B. Shellan 30 Jul. 1990 4 p
(Contract N00014-90-C-0145)
(AD-A225969) Avail: NTIS HC/MF A01 CSCL 20/6

Conventional Holographic Coatings (HC) have been fabricated for use in high energy lasers, integrated optics, and in filters designed to reduce background clutter in surveillance and laser radar systems. In most of these cases, the coatings are nearly periodic and designed to reflect radiation over a narrow spectral bandwidth. The goal of the current program is to develop a relatively simple technique for fabricating HC's with nearly any desired reflectivity spectral profile. These components could be used as matched filters to greatly increase the signal-to-clutter ratio (SCR) in tracking and surveillance. Dim targets viewed against low contrast backgrounds could be more easily detected using these filters, if the target and backgrounds had different spectral profiles. In one version of the proposed concept, the turning mirror is rotated during the HC exposure, thus generating a continuum of different holographic grating periods within the photosensitive material. The intensity of the recording laser is modulated during the exposure in order to produce a HC with a specified reflectivity profile. In the second approach being investigated, the hologram is only exposed at several discrete angles, rather than a continuum of angles. If the matched filter HCs can be produced, they can be used to improve the detection of targets (e.g., boosters or even against an Earth background) or background material of interest (e.g., specific vegetation or minerals from satellites). GRA

N91-12920# Rome Air Development Center, Griffiss AFB, NY.
MILLIMETER WAVE TWT LIFE TEST MONITOR Report, Jan. 1986 - Jun. 1990
Leon L. Stevens, James Perretta, and Curt Belusar Jul. 1990 123 p
(AD-A226111; RADC-TR-90-202) Avail: NTIS HC/MF A06
CSCL 14/2

This report presents information on a monitor which can be used to capture and store life test data in real time. The hardware is specifically tailored to capture data without delay in real time. In addition to data acquisition, this report presents information on hardware and programs which can be used to transfer data to larger multitask computer systems where data analysis is more efficient. Because all multitask computer systems (even those as small as PCs) devote considerably amounts of time to tasks other than running the user's test program, they are not directly compatible with real-time data acquisition. Outside hardware is required to buffer real-time data and pass it to the computer system where final data reduction takes place. The interface hardware described in this report consists of two single task microprocessor systems. One system is based on the Motorola 6800 cpu with an SS50 mother board and SS30 input/output slots. The second system is a single board Motorola 6802 microprocessor. GRA

N91-12921# Pennsylvania State Univ., State College. Applied Research Lab.
EVALUATION OF FLUSH MOUNTED HOT-FILM SENSORS FOR SKIN FRICTION REDUCTION MEASUREMENTS IN VISCOELASTIC POLYMER SOLUTIONS
W. L. Harbison and H. L. Petrie 27 Aug. 1990 32 p
(Contract N00039-88-C-0051)
(AD-A226121; PSU/ARL-TM-90-181) Avail: NTIS HC/MF A03
CSCL 14/2

The performance of flush mounted hot-film sensors for mean wall shear stress measurement in turbulent flows of dilute drag reducing polymer solution is evaluated. A series of pipe flow experiments were conducted to compare the level of skin friction reduction measured by hot-film sensors with values determined from the pipe pressure drop. Water calibrated hot-film sensors consistently underestimate the wall shear stress in the dilute polymer flows. For the range of flows tested, hot-film determined percent drag reductions are low but generally within 15 percent of the correct value. Like drag reduction, heat transfer reduction results from the elastic properties of polymer solutions. These two phenomena are distinct and their differences suggest that Reynolds' analogy is not valid in the dilute polymer flows. GRA

N91-12922# Sandia National Labs., Albuquerque, NM. Dept. of Experimental Mechanics.
EVALUATION OF UNIAXIAL AND TRIAXIAL SHOCK ISOLATION TECHNIQUES FOR A PIEZORESISTIVE ACCELEROMETER
Vesta I. Bateman, R. Glenn Bell, III, Fred A. Brown, Neil T. Davie, and Michael A. Nusser 1990 10 p Presented at the 61st Shock and Vibration Symposium, Pasadena, CA, 16-18 Oct. 1990
(Contract DE-AC04-76DP-00789)
(DE91-000773; SAND-90-1579C; CONF-9010172-4) Avail: NTIS HC/MF A02

Development of both uniaxial and triaxial shock isolation techniques for pyroshock and impact tests has continued this year. The uniaxial shock isolation technique has demonstrated acceptable characteristics for a temperature range of -50 F to +186 F and a frequency bandwidth of DC to 10 kHz. The triaxial shock isolation technique has demonstrated acceptable results for a temperature range of -50 F to 70 F and a frequency bandwidth of DC to 10 kHz. DOE

N91-12923# Oxford Univ. (England). Robotics Research Group.
EPIPOLAR GEOMETRY FOR TRINOCULAR ACTIVE RANGE-SENSORS
A. Blake, D. McCowen, H. R. Lo, and D. Konash Apr. 1990 11 p Sponsored by United Kingdom Science and Engineering Research Council
(OUEL-1850/90; ETN-90-98226) Avail: NTIS HC/MF A03

The design of trinocular active range sensors is discussed. Such devices have the advantage of freedom from mechanical scanning, and rapid image capture. The main technical problem is overcoming the correspondence problem. This requires careful geometric design to take account of epipolar geometry and thorough modeling of image measurement error. A design that, so far, seems to work well is presented. It involves setting up the projector-camera geometry to be degenerate, so that depth computation is ill-conditioned, and then backing off a little. ESA

N91-13331*# Wichita State Univ., KS. Dept. of Aerospace Engineering.
AERODYNAMICS SUPPORT OF RESEARCH INSTRUMENT DEVELOPMENT
L. Scott Miller *In* Hampton Univ., NASA/American Society for

Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 88-89 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 14B

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N91-12924# Oak Ridge National Lab., TN. Chemical Physics Section.
LARGE COLLECTIVE LAMB SHIFTS IN HIGH PRESSURE NOBLE GASES
M. G. Payne, W. R. Garrett, Roger C. Hart, Irene Datskou, and James Wray (Berea Coll., KY.) 1990 7 p Presented at the 5th International Symposium on Resonance Ionization Spectroscopy and Its Applications, Varese, Italy, 16-21 Sep. 1990
(Contract DE-AC05-84OR-21400)
(DE90-017761; CONF-9009174-3) Avail: NTIS HC/MF A02

When three-photon atomic excitation is produced by two laser beams of angular frequencies, omega(sub L1) and omega(sub L2), which are crossed at an angle, theta, large cooperative pressure dependent shifts can be produced in the peak position of the excitation lineshape. By studying an experimental situation in xenon the theoretical predictions are shown to be in precise agreement with experiment for several angles and a wide range of pressures. The possibility of observing related shifts in nonlinear processes (such as backward stimulated hyper-Raman generation) is discussed. DOE

N91-12925# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
NUMERICAL SIMULATION OF CRATER FORMATION HEATING BY LASER BEAM. ANALYSIS OF RADIATION EXCHANGES IN THE CAVITY Ph.D. Thesis - Paris VI Univ.
Philippe Barillot Aug. 1990 215 p In FRENCH; ENGLISH summary Report will also be announced as translation (ESA-TT-1234)
(ONERA-NT-1990-5; ISSN-0078-3781; ETN-90-98022) Avail: NTIS HC/MF A10

Drilling process are investigated. The numerical sublimation problem involves an axisymmetric target irradiated by a fixed laser beam. The whole radiation is supposed to be absorbed. The numerical solution of the transient heat equation involves an implicit finite difference method. The coordinate transformation of Landau is used to immobilize and straighten the complex moving boundary. To reduce computation time, an iterative method is used to solve the matrix equations. The reflections of laser beam and the wall cavity emissivity are studied. The numerical model reproduces three models of radiation reflections on the cavity wall: specular, diffused, and mixed. The last two are solved using radiosity method and the first one is solved using a new method. Applications are made on a graphite material, lighted by a Gaussian laser beam. The results show a rapid deformation of the interface in the case of specular reflections. A significant increase of drilling rate is detected. The same trend is observed in the mixed case, on a lower scale. ESA

N91-12926# Lawrence Livermore National Lab., CA. Chemical and Laser Science Div.
XUV FREE-ELECTRON LASER-BASED PROJECTION LITHOGRAPHY SYSTEMS
Brian E. Newnam 1990 15 p Presented at the SPIE Conference on EUV X Ray and Gamma Ray Instrumentation for Astronomy, San Diego, CA, 8-13 Jul. 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE91-000441; LA-UR-90-2975; CONF-9007157-2) Avail: NTIS HC/MF A03

Free-electron laser sources, driven by RF-linear accelerators, have the potential to operate in the extreme ultraviolet (XUV) spectral range with more than sufficient average power for high-volume projection lithography. For XUV wavelengths from 100 nm to 4 nm, such sources will enable the resolution limit of optical projection lithography to be extended from 0.25 to 0.5 micron and with an adequate total depth of focus (1 to 2 microns). Recent developments of a photoinjector of very bright electron beams, high-precision magnetic undulators, and ring-resonator cavities raise our confidence that FEL operation below 100 nm is ready for prototype demonstration. We address the motivation for an XUV FEL source for commercial microcircuit production and its integration into a lithographic system, include reflecting reduction masks, reflecting XUV projection optics and alignment systems, and surface-imaging photoresists. DOE

N91-12927# Los Alamos National Lab., NM.
LASING ON HIGHER HARMONICS
Roger W. Warren 1990 12 p Presented at the 12th International Free Electron Laser Conference, Paris, France, 17-21 Sep. 1990
(Contract W-7405-eng-36)
(DE91-000448; LA-UR-90-2932; CONF-9009166-4) Avail: NTIS HC/MF A03

Lasing at short wavelengths with an accelerator of modest energy can only be achieved with a wiggler of short period and high field operating, perhaps, at a high harmonic of the fundamental frequency. The characteristics of wigglers of this kind, designed to lase with harmonic numbers as large as fifty or so, emphasizing their gain, efficiency, and sensitivity to emittance and energy spread are discussed. DOE

N91-12928# Naval Postgraduate School, Monterey, CA.
COMPUTER SIMULATION OF A LASER DESIGNATOR IN THE OPERATIONAL ENVIRONMENT M.S. Thesis
Dong-ho Choi Dec. 1989 79 p
(AD-A225411) Avail: NTIS HC/MF A05 CSCL 19/5

This thesis presents a computer simulation program designed to predict the performance of a laser designator in an operational environment. It uses aspects of Fourier optical theory, atmospheric modulation transfer function, atmospheric transmittance, and turbulence to analyze the spot size and the power on a target. The guidance system requires the specific power and spot size on a target to track it. So the optimum laser designator for special military purpose can be chosen by the output of this program for a particular atmospheric condition. GRA

N91-12929# Army Missile Command, Redstone Arsenal, AL. Directed Energy Directorate.
A PERFORMANCE ANALYSIS AND CHARACTERIZATION OF THE LUMONICS, INC. HYPERDYE-300 LASER PUMPED DYE LASER Final Technical Report
Travis S. Taylor, Wayne E. Davenport, and John J. Ehrlich 11 Jul. 1990 32 p
(AD-A225784; AD-E951523; AMSMI/TR-RD-DE-90-2) Avail: NTIS HC/MF A03 CSCL 09/3

The laser analyzed in this research, the Lumonics, Inc. HyperDYE-300 laser pumped dye laser, was procured via the FSTC D650 Program and was characterized in order to support the technology development of that program. The dye laser was pumped with a Neodymium:YAG q-switched laser and it utilized Rhodamine-6G in methanol. It was found to be tunable from about 545 nm to 590 nm and produced a maximum ouput energy of 56 percent of the pump beam energy. The analysis involved the measuring of optimum dye/solvent concentration, output energy versus tunability, optical efficiency versus tunability, temporal and spatial profiles, beam divergence, linewidth, and amplified spontaneous emission versus laser emission. GRA

N91-12930# Washington State Univ., Pullman. Dept. of Physics.
BASIC CHARACTERISTICS OF LASER HEATING IN THERMOLUMINESCENCE AND OF LASER-STIMULATED LUMINESCENCE Final Report, 15 Jul. 1982 - 28 Feb. 1990
Peter F. Braunlich 15 Jul. 1990 48 p
(Contract N00014-82-K-0529)
(AD-A225968) Avail: NTIS HC/MF A03 CSCL 07/5

This report summarizes the work on laser-stimulable luminescence. The effort emphasized three aspects: (1) investigation of basic laser-stimulated luminescence phenomena such as laser-heated thermoluminescence for radiation dosimetry and optical (non-thermal) stimulated luminescence for potential application in radiation imaging and personnel dosimetry; (2) graduate student training and interaction with guest scientists; and (3) technology transfer to U.S. industry. GRA

N91-12931# Duke Univ., Durham, NC. Dept. of Physics.
RESEARCH ON ADVANCED SOURCES AND APPLICATIONS Final Report, 1 Jul. 1988 - 31 Oct. 1989
John M. Madey and Rodney I. McCormick 3 Aug. 1990 18 p
(Grant AF-AFOSR-0238-88; AF Proj. 2301)
(AD-A225997; AFOSR-90-0895TR) Avail: NTIS HC/MF A03 CSCL 20/7

Progress is summarized on the mechanical and shielding systems for a 1 GeV Linac and Storage Ring to drive an UV/XUV Free Electron Laser. Progress is summarized on injector redesign and undulator design. Training and coupling activities are summarized. GRA

N91-12932# Princeton Univ., NJ. Plasma Physics Lab.
SOFT X RAY LASER DEVELOPMENT Final Report, Oct. 1988 - Oct. 1989
Szymon Suckewer Oct. 1989 45 p
(Grant AF-AFOSR-0066-86)
(AD-A226071; AFOSR-90-0881TR) Avail: NTIS HC/MF A03 CSCL 09/3

A 3mJ, 182-Anstrom soft x ray laser based on a recombining plasma was created with an efficiency almost two orders of magnitude higher than the collisionally-pumped Livermore device. In addition, an amplifier section was added, consisting of a 3mm long carbon plasma which yielded a gain of 8 per cm. GRA

N91-12933*# Hampton Univ., VA. Dept. of Physics.
IODOPERFLUOROHEXANE AS A LASANT FOR IODINE LASERS M.S. Thesis Final Report
Clarence L. Wells Jul. 1990 85 p Sponsored in part by Total Army Personnel Agency (Provisional), Alexandria, VA
(Grant NAG1-400)
(NASA-CR-187434; NAS 1.26:187434; AD-A226215) Avail: NTIS HC/MF A05 CSCL 09/3

A comparative analysis is made of iodoperfluorohexane (C6F13I) to iodoperfluoropropane (C3F7I) when used as the gain medium in an iodine laser system. Parameters for this comparison are the absorption cross section in the pumpband 250 to 290 nanometers, laser output energy, and the production of the molecular iodine (I2), the major quenching by-product of iodine laser reactions. This study confirms that C6F13I has an absorption cross section that is almost equal to C3F7I and laser output energy as high as 1.5 times greater. The amount of I2 produced is less in C6F13I due to an I2 elimination and recombination processes that are yet to be fully understood. GRA

N91-12934# Ballistic Research Labs., Aberdeen Proving Ground, MD.
ULTRAVIOLET EXCIMER LASER-BASED IGNITION OF H2/AIR AND H2/O2 PREMIXED FLOWS Progress Report, Oct. 1988 - Oct. 1989
Brad E. Forch, Andrzej W. Miziolek, Jeffrey B. Morris, Clifton N. Merrow, and Randy J. Locke (National Academy of Sciences - National Research Council, Washington, DC.) Aug. 1990 23 p
(DA Proj. 1L1-61102-AH-43)
(AD-A226389; BRL-TR-3124) Avail: NTIS HC/MF A03 CSCL 09/3

Very efficient ignition was demonstrated of H2/air and H2/O2 premixed flows at room temperature and atmospheric pressure using the radiation from a focussed ArF excimer laser (193nm). Incident pulse laser energies of less than 1 mj for H2/O2 and 6 mj for H2/air are required for ignition with the minimum occurring for lean mixtures. The ignition is due to efficient formation of microplasmas. Unlike the laser-produced microplasmas that are formed by non-resonant photon absorption processes, the resonant ones are easily controlled with respect to spark energy content and thus could be quite useful as potential igniters for the NASP plane and for other supersonic/hypersonic air breathing applications. It was also found that the atmospheric absorption of the ArF laser radiation strongly affects the values for the incident laser energy (ILE) that is required for ignition. Finally, the efficient ignition is reported of C2H2/air by the ArF laser which suggests that this UV laser ignition source may have a wider range of applicability. GRA

N91-12935# Oak Ridge National Lab., TN. Analytical Chemistry Div.
MATRIX-ASSISTED LASER DESORPTION FOURIER TRANSFORM MASS SPECTROMETRY FOR BIOLOGICAL COMPOUNDS
Robert Hettich and Michelle Buchanan 1990 9 p Presented at the NATO Advanced Research Workshop on Methods and Mechanisms for Producing Ions From Large Molecules, Minaki, Ontario, 24-28 Jun. 1990 Submitted for publication
(Contract DE-AC05-84OR-21400)
(DE91-000393; CONF-9006271-2) Avail: NTIS HC/MF A02

The recent development of matrix-assisted UV laser desorption (LD) mass spectrometry has made possible the ionization and detection of extremely large molecules (with molecular weights exceeding 100,000 Daltons). This technique has generated enormous interest in the biological community for the direct examination of large peptides and oligonucleotides. Although this matrix-assisted ionization method has been developed and used almost exclusively with time-of-flight (TOF) mass spectrometers, research is currently in progress to demonstrate this technique with trapped ion mass spectrometers, such as Fourier transform ion cyclotron resonance mass spectrometry (FTMS). The potential capabilities of FTMS for wide mass range, high resolution measurement, and ion trapping experiments suggest that this instrumental technique should be useful for the detailed structural characterization of large ions generated by the matrix-assisted technique. We have recently demonstrated that matrix-assisted ultraviolet laser desorption can be successfully used with FTMS for the ionization of small peptides. The objective of this report is to summarize the application and current limitations of matrix-assisted laser desorption FTMS for the characterization of peptides and oligonucleotides at the isomeric level. DOE

N91-12936# Sandia National Labs., Albuquerque, NM. Metallurgical Process Div.
CHARACTERIZATION OF A LASER-BEAM SPINNING TECHNIQUE
Eldon Brandon Jun. 1990 20 p
(Contract DE-AC04-76DP-00789)
(DE91-000478; SAND-88-1215) Avail: NTIS HC/MF A03

The objective of this study was to evaluate the beam spinning technique for bridging gaps in butt joints that are CO2 laser-welded. A device was designed and built to circularly oscillate a CO2 laser beam on the plant of a work surface. A series of welds was made using a continuous-wave output power of 805 watts, and the resultant weld bead profile was characterized as a function of three process parameters. From the experimental results, predictor equations were derived for laser-beam spinning speed and amplitude of the beam spinning pattern on the work surface. The data collected in this experiment indicate that the width of the weld bead is increased by oscillating the beam and that this increase may be made without significantly reducing the weld penetration. The increased width of the weld may offer a solution to variable gaps in weld joints, which has been a recurring production problem. DOE

N91-12937# Brookhaven National Lab., Upton, NY. National Synchrotron Light Source.
UNIVERSAL SCALING FUNCTION FOR FEL GAIN
L. H. Yu, S. Krinsky, and R. L. Gluckstern (Maryland Univ., College Park.) 1990 15 p Presented at the 12th International Free Electron Laser Conference, Paris, France, 17-21 Sep. 1990

(Contract DE-AC02-76CH-00016)
(DE91-001124; BNL-45152; CONF-9009166-8) Avail: NTIS HC/MF A03

We have developed an analytic calculation of FEL gain in the exponential regime taking into account the finite emittance, energy spread, focusing and betatron oscillation of the electron beam, and the diffraction and guiding of the radiation. The gain is expressed in terms of a universal scaling function with only three independent parameters. Excellent agreement is found with results of numerical simulation. DOE

N91-12938# Brookhaven National Lab., Upton, NY.
PROPOSED UV-FEL USER FACILITY AT BNL
I. Ben-Zvi, L. F. DiMauro, S. Krinsky, M. G. White, and L. H. Yu 1990 15 p Presented at the 12th International Free Electron Laser Conference, Paris, France, 17-21 Sep. 1990
(Contract DE-AC02-76CH-00016)
(DE91-001131; BNL-45161; CONF-9009166-7) Avail: NTIS HC/MF A03

The NSLS at Brookhaven National Laboratory is proposing the construction of a UV-FEL operating in the wavelength range from visible to 1000 A. Nano-Coulomb electron pulses will be generated at a laser photo-cathode RF gun at a repetition rate of 10 KHz. The 6 ps pulses will be accelerated to 250 MeV in a superconducting linac. The FEL consists of an exponential growth section followed by a tapered section. The amplifier input is a harmonic of a tunable visible laser generated either by nonlinear optical material or the non-linearity of the FEL itself. The FEL output in 10(exp -4) bandwidth is 1 mJ per pulse, resulting in an average power of 10 watts. The availability of radiation with these characteristics would open up new opportunities in photochemistry, biology and non linear optics, as discussed in a recent workshop held at BNL. DOE

N91-12939# Washington Univ., Seattle. Dept. of Applied Mathematics.
FREE-ELECTRON LASERS WITH VERY SLOW WIGGLER TAPER
D. L. Bosley and J. Kevorkian Sep. 1990 32 p
(Contract DE-FG06-86ER-25019)
(DE91-001139; DOE/ER-25019/20; TR-90-07) Avail: NTIS HC/MF A03

A highly accurate, explicit asymptotic solution of the electron energy and phase is found for a class of free-electron lasers with very long wavelength beams, very low electron energies, and very slow taper of the wiggler field relative to the wiggler period. Dimensionless variables are defined and normalized, and three small parameters which characterize the operation of the FEL are identified. Because of the explicit nature of the solution, our results may be directly used to calculate features such as the escape distance of the electron from the potential well and the effects of the various physical parameters. One important advantage of the very slow wiggler taper is the increased efficiency of the energy transfer from the electron beam to the signal field due to increased bucket width. Numerical calculations are performed to verify all results. DOE

N91-12940# Lawrence Livermore National Lab., CA.
CALCULATION OF SOFT X RAY LASERS AT 44.8(ANGSTROM) AND 43.1(ANGSTROM)
S. Maxon, B. MacGowan, S. Dalhed, R. A. London, M. D. Rosen, P. L. Hagelstein, B. Busch, and G. Charatis (KMS Fusion, Inc., Ann Arbor, MI.) 1990 20 p Presented at the 2nd International Colloqium on X Ray Lasers, York, England, 17-21 Sep. 1990
(Contract W-7405-eng-48)
(DE91-000818; UCRL-JC-104983; CONF-9009266-1-Vugraphs) Avail: NTIS HC/MF A03

This report contains viewgraphs of results of calculations on soft x ray lasers. Ionization, spectral lines, shapes, and energy-level transitions are some of the calculations made. DOE

N91-12941# Los Alamos National Lab., NM.
TARGET PHYSICS RESULTS AT 248 nm WAVELENGTH FROM THE AURORA LASER SYSTEM HIGH-INTENSITY CAMPAIGN
R. G. Watt, J. Cobble, C. Gomez, J. Kephart, R. Kristal, T. P. Turner, J. Oertel, S. Thomas, D. Netz, and J. Jones Oct. 1990 32 p
(Contract W-7405-eng-36)
(DE91-000887; LA-11826-MS) Avail: NTIS HC A03/MF A01

Au and Si targets have been irradiated using the Aurora KrF laser system, and diagnosed with x ray and optical diagnostics. The x ray diagnostics were sensitive to the 0.1 to 10 keV range. Initial, manually aligned results indicate significant plasma heating and intense x ray production, with incident peak intensities on target of 1-2 x 10(exp 14) W/sq cm in a focal spot of order 500 microns diameter. Total energy delivered to the target in 36 of the available 48 target beams was approximately 1200 J in pulses with FWHM in the 3 to 5 ns range. M-band radiation was observed from Au foil targets. Initial bandwidth measurements on the laser indicate approx. 20 per cm without bandwidth enhancement efforts. DOE

N91-12942# Institut Franco-Allemand de Recherches, Saint-Louis (France).
THERMOCAPILLARY CONVECTION IN LASER IRRADIATED LIQUIDS [THERMOKAPILLARE KONVEKTION IN LASERBESTRAHLTEN FLUESSIGKEITEN]
M. Schellhorn 23 Mar. 1989 35 p In GERMAN Presented at Kommissionssitzung des WB fuer die Schwerpunktaufgabe 2.3 Laser, St. Louis, France, 14 Feb. 1989; and at Fruehjahrstagung der Deutschen Physikalischen Gesellschaft, Essen, Fed. Republic of Germany, 6-10 Mar. 1989
(ISL-CO-214/89; ETN-90-98029) Avail: NTIS HC/MF A03

The two dimensional model of the time dependent energy transfer by conduction and convection is developed to calculate the velocity distribution in a melting body and the temperature distribution in the melting mass and in the solid mass due to a laser irradiation. The calculations on the interaction of a laser CO2 radiation with a steel target show the influence of the steel characteristics on the velocity and the temperature and the geometry of the melting mass. Experiments were carried out with ethanol irradiated by a CO2 laser, which showed a good agreement with the model. ESA

N91-12943# Institut Franco-Allemand de Recherches, Saint-Louis (France).
INFLUENCE OF THERMOCAPILLARY CONVECTION ON THE TEMPERATURE DISTRIBUTION AND THE GEOMETRY OF THE MELT [EINFLUSS DER THERMOKAPILLAREN KONVEKTION AUF DIE TEMPERATURVERTEILUNG UND GEOMETRIE DES SCHMELZPOOLS]
M. Schellhorn 25 May 1990 40 p In GERMAN
(ISL-R-106/89; ETN-90-98038) Avail: NTIS HC/MF A03

A two-dimensional model is developed, which describes the energy transfer in a body under laser radiation by taking into account the convection energy in the melt. Dimensionless equations were established to point out the Marangoni and Prandtl numbers and the melting temperature, whose influence on the temperature and velocity distribution was observed. For a target of Al2O3 ceramics the ablation rate was calculated with the process parameters. It is shown that the drop in temperature at the target surface, due to the thermocapillary convection is so important that no ablation appears. ESA

N91-12944# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
SEMICONDUCTOR LASER: RELATION BETWEEN THE LINE WIDTH AND THE MODE DISTRIBUTION Ph.D. Thesis [HALBLEITERLASER; ABHAENGIGKEIT DER LINIENBREITE VON DER MODENVERTEILUNG]
Udo Krueger 1990 143 p In GERMAN
(ETN-90-98181) Avail: NTIS HC/MF A07

The line width of a semiconductor laser is calculated with

numerous modes and an approximation with only two modes is achieved with particular consideration to the saturation coefficients and the interaction of the modes. Measurements of the line width and the frequency noise spectrum were achieved and the mode distribution of the laser was influenced by the variation of the position of a small external reflector. An interferometer structure for a semiconductor laser was described. ESA

N91-12945# ANT Nachrichtentechnik, Backnang (Germany, F.R.). Produktbereich Raumfahrt.
HIGH POWER OPTICAL TRANSMITTER PACKAGE Final Report
Ulrich Hildebrand, Bodo Menke, Gerhard Ohm, Thomas Spatschek, and Theodor Wiesmann Apr. 1990 56 p In GERMAN; ENGLISH summary
(Contract BMFT-01-YH-88/62)
(ETN-90-98197) Avail: NTIS HC/MF A04

A high power transmitting package for free space optical communication was carried out, using a high power Laser Diode Array (LDA). High power LDAs are used as optical sources. As beam shaping of the output beam of LDAs is necessary for use in optical free space communication, several beam shaping methods were investigated. The apertured mirror scheme was chosen, for construction of a prototype transmitter package. As a result, a laser diode transmitter package was built, which is able to emit 1 W sub pp optical output power at a bit rate of 120 megabytes per second QPPM (Quaternary Pulse Position Modulation). ESA

N91-13316*# Eureka Coll., IL.
NOISE IN LASER OSCILLATOR SYSTEMS
Joseph C. Hafele *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 54-55 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20E

N91-13335*# Hampton Univ., VA. Dept. of Physics.
A MODIFIED PUMP LASER SYSTEM TO PUMP THE TITANIUM SAPPHIRE LASER Abstract Only
Larry B. Petway *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 95 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 11F

N91-13339*# College of Southern Georgia, Statesboro. Dept. of Mathematics and Computer Science.
A RATE EQUATION APPROACH TO GAIN SATURATION EFFECTS IN LASER MODE CALCULATIONS
Lila F. Roberts *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 104-106 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N91-12946 Texas Univ., Austin.
HIGH ACCURACY POSITION CONTROL OVER A LARGE RANGE USING A MACRO/MICRO ROBOT PAIR SYSTEM WITH A MAGNETIC LEVITATION MICRO-ROBOT Ph.D. Thesis
Myung Chan Jeong 1989 206 p
Avail: Univ. Microfilms Order No. DA9016903

A macro/micro robot pair system with endpoint sensing has been suggested by many researchers in the robotics field recently as a means to circumvent the limited accuracy and speed of a conventional robot. Most of the work on robot pair systems has concentrated on developing a robust controller to solve the dynamic coupling problem which comes from the force interaction between the macro-robot and the micro-robot. A macro/micro robot pair system was developed with a magnetic levitation micro-robot which is almost dynamically decoupled so that a pair control strategy can be used which employs each element's controller without modification. The macro-robot acts merely as a transportation system with high speed for the micro-robot which actually carries out the micron level task. The function of the proposed pair system mainly depends on the ability of the micro-robot itself rather than the pair control strategy, so concentration can be placed on developing a micro-robot which is suitable for the specific application of line tracking. The general aspects of the micro-robot are also discussed. The feasibility of using the developed magnetic levitation micro-robot in a large workspace is shown while maintaining its high accuracy. The macro-robot and micro-robot were designed, built, and integrated. The special apparatus for verifying the results was devised. A +/- 20 micron tracking accuracy over an 8 cm range was demonstrated by the pair system. Note that the working range of 8 cm is limited by the test set-up, and the actual working range is the same as the macro-robot's workspace. Improvements of the pair system performance are also considered. Dissert. Abstr.

N91-12947 ESDU International Ltd., London (England).
PROCEDURES FOR BALANCING PLANAR LINKAGES USING ROTATING COUNTERWEIGHTS Abstract Only
Jun. 1990 40 p
(ESDU-90007; ISBN-0-85679-732-4; ISSN-0141-4046) Avail: ESDU

The methods are given for partially balancing single-degree-of-freedom multi-bar linkages by adding counterweights rotating at constant speed. The methods are: (1) Lanchester Balancer using two equal counter rotating weights sized and aligned to eliminate a single frequency term of the frame shaking force; (2) a single weight sized and aligned to minimize the average shaking force; (3) Generalized Lanchester Balancer using two equal counter rotating weight sized and aligned to eliminate a single frequency term of both the frame shaking force and moment; and (4) a moment balancer using two equal weights rotating in the same direction and sized and aligned to eliminate only the first-order frequency of the frame shaking moment. The mass-moment and orientation of each counterweight are determined by a step-by-step procedure that, in the case of the Generalized Lanchester Balancer, also provides the location for the axis for the second counterweight. Worked examples show the practical use of the procedures in the design of a crank-rocker linkage and in retrofitting a slider-crank mechanism. ESDU

N91-12948 Texas A&M Univ., College Station.
A NEW METHOD FOR DETERMINING ROTORDYNAMIC FORCES ON LIQUID ANNULAR SEALS Ph.D. Thesis
Steve John Hensel 1990 101 p
Avail: Univ. Microfilms Order No. DA9027221

A new method capable of determining liquid rotordynamic coefficients on various rotating turbomachinery components was developed and applied to annular seals. The analysis is applicable to a small circular motion about the centric position. The method is based on solving the incompressible turbulent flow field associated with the operation of a general component using a finite element approach. A new concept employing element deformation is used to model the eccentricity within the component. The deformable grid is unlike popular adaptive grid methods in that the grid deformation is caused by virtual displacements of the computational nodes in the new method, as opposed to physically generating a new grid at each time step. Results of this new method are in excellent agreement with the cross-coupled stiffness and direct damping coefficients obtained by measurements and other analytical methods. The current method overpredicts the cross-coupled damping and direct inertia coefficients compared with other analytical methods. Dissert. Abstr.

N91-12949# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
DYNAMICALLY STABLE LEGGED LOCOMOTION
Marc H. Raibert, H. B. Brown, Jr., Michael Chepponis, Jeff

Koechling, Jessica K. Hodgins, Diane Dustman, W. Kevin Brennan, David S. Barrett, Clay M. Thompson, and John Daniell Hebert et al Sep. 1989 213 p Sponsored in part by System Development Foundation
(Contract MDA903-85-K-0179)
(AD-A225713; AI-TR-1179; LL-6) Copyright Avail: NTIS HC/MF A10 CSCL 12/9

This report documents our study of active balance in dynamic legged systems. The purpose of this research is to build a foundation of knowledge that can lead both to the construction of useful legged vehicles and to a better understanding of animal locomotion. In this report we focus on the control of biped locomotion, the use of terrain footholds, running at high speed, biped gymnastics, symmetry in running, and the mechanical design of articulated legs. GRA

N91-12950# Ballistic Research Labs., Aberdeen Proving Ground, MD.
SUPERCONDUCTING AND COMPUTATIONAL PENETRATION MECHANICS Final Report, Jun. 1989 - Jun. 1990
J. A. Zukas and K. D. Kimsey Aug. 1990 40 p
(DA Proj. 1L1-62618-AH-80)
(AD-A226267; BRL-TR-3143) Avail: NTIS HC/MF A03 CSCL 19/10

This report provides an overview of various aspects of numerical simulation of the dynamics of impacting continuous bodies. Emphasis is placed on impact scenarios, wherein the loading conditions are sufficiently intense to produce large deformations and penetrations. Such events are characterized by loading and response times in the microsecond regime. Furthermore, the deformations are highly localized and are governed by properties of the materials within the affected region as opposed to the global characteristics of the structure in which they are contained. Selected two- and three-dimensional examples of high velocity penetration are presented. Practical aspects of performing large-scale simulations of penetration phenomena on modern supercomputers are discussed. GRA

N91-12951# Sandia National Labs., Livermore, CA. Applied Mechanics Dept.
A TWO-DIMENSIONAL THERMOMECHANICAL SIMULATION OF A GAS METAL ARC WELDING PROCESS
A. R. Ortega Aug. 1990 30 p
(Contract DE-AC04-76DR-00789)
(DE91-000489; SAND-90-8204) Avail: NTIS HC/MF A03

A low heat input gas metal arc (GMA) weld overlay process is being investigated as a possible means to repair Savannah River nuclear reactor tanks in the event cracks are detected in the reactor walls. Two-dimensional thermomechanical simulations of a GMA welding process were performed using the finite element code ABAQUS to assist in the design of the upcoming weld experiments on helium-charged specimens. The thermal model correlated well with existing test data, i.e., fusion zone depth and thermocouple data. In addition, numerical results revealed that after cool-down the final deformation of the workpiece was qualitatively similar to the shape observed experimentally. Based on these analyses, conservative recommendations were made for the workpiece dimensions, weld pass spacing, and thermomechanical boundary conditions to ensure the experiments would be as representative as possible of welding on the reactor walls. DOE

N91-12952# GTE Labs., Inc., Waltham, MA.
ANALYTICAL AND EXPERIMENTAL EVALUATION OF JOINING SILICON NITRIDE TO METAL AND SILICON CARBIDE TO METAL FOR ADVANCED HEAT ENGINE APPLICATIONS Final Report
S. Kang, J. H. Selverian, H. Kim, D. ONiel, and K. Kim Apr. 1990 141 p Prepared for ORNL, TN
(Contract DE-AC05-84OR-21400)
(DE91-000535; ORNL/Sub-87-SB047C/1) Avail: NTIS HC/MF A07

This report summarizes the results of Phase 1 of Analytical and Experimental Evaluation of Joining Silicon Nitride to Metal and Silicon Carbide to Metal and Silicon Carbide to Metal for Advanced Heat Engine Applications. A general methodology was developed to optimize the joint geometry and material systems for 650 and 950 C applications. Failure criteria were derived to predict the fracture of the braze and ceramic. Extensive finite element analyses (FEA), using ABAQUS code, were performed to examine various joint geometries and to evaluate the affect of different interlayers on the residual stress state. Also, material systems composed of coating materials, interlayers, and braze alloys were developed for the program based on the chemical stability and strength of the joints during processing and service. Finally, the FEA results were compared with experiments using an idealized strength relationship. The results showed that the measured strength of the joint reached 30 to 90 percent of the strength by predicted by FEA. Overall results demonstrated that FEA is an effective tool for designing the geometries of ceramic-metal joints and that joining by brazing is a relevant method for advanced heat engine applications. DOE

N91-12953# EG and G Rocky Flats, Inc., Golden, CO. Nuclear Joining Div.
DEVELOPMENT OF MODELS FOR WELDING APPLICATIONS Final Report
J. R. Roper and L. K. Hayer 1990 21 p Presented at the MARC Finite Element Analysis Users Conference, Monterey, CA, 20-21 Sep. 1990
(Contract DE-AC34-90DP-6234)
(DE91-001101; RFP-4432; CONF-9009231-2) Avail: NTIS HC/MF A03

The modeling of welding processes offers considerable potential for help with manufacturing problems but a complete definition of any welding process offers many challenges. However, the modular structure of MARC, and the diverse range of capabilities offered, create a good opportunity for development in this area. This paper discusses these problems and describes techniques used to overcome some of them. Models have been developed to simulate gas tungsten arc (GTA) and electron beam (EB) welding with a moving heat source. FORTRAN routines for subroutines FLUX and FORCDT have been written to generate a moving heat source. Sequential element activation has permitted the simulation of GTA welding with cold wire feed (CWF), as in filling of a machined weld groove. A program which generates History Definition blocks necessary for this type of welding model is also described in this paper. Semi-infinite heat transfer elements were used to get accurate temperature histories while keeping the size of the model manageable. Time-temperature histories and isothermal contours compare well with experimental measurements, although many areas for improvement and refinement remain. Results have been used to anticipate the necessity for weld parameter changes after part redesign, and the electron beam model relates closely to situations in which information is needed for the minimization of peak temperatures on the underside of the welded part. DOE

N91-12954*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FINITE ELEMENT ANALYSIS OF THERMAL DISTORTION EFFECTS ON OPTICAL PERFORMANCE OF SOLAR DYNAMIC CONCENTRATOR FOR SPACE STATION FREEDOM
Michael P. Doherty and Vithal Dalsania Jul. 1990 18 p Original contains color illustrations
(NASA-TM-102504; E-5305; NAS 1.15:102504) Avail: NTIS HC/MF A03; 3 functional color pages CSCL 20K

An analysis was performed to predict the thermal distortion of the solar dynamic concentrator for Space Station Freedom in low earth orbit and to evaluate the effects of that thermal distortion on concentrator on-orbit performance. The analysis required substructural finite element modeling of critical concentrator structural subsystems, structural finite element modeling of the concentrator, mapping of thermal loading onto the structural finite element model, and the creation of specialized postprocessors to assist in interpreting results. Concentrator temperature distributions

and thermally induced displacements and slope errors and the resulting receiver flux distribution profiles are discussed. Results determined for a typical orbit indicate that concentrator facet rotations are less than 0.2 mrad and that the change in facet radius due to thermal flattening is less than 5 percent. The predicted power loss due to thermal distortion effects is less than 0.3 percent. As a consequence the thermal distortions of the solar dynamic concentrator in low earth orbit will have a negligible effect on the flux distribution profiles within the receiver. Author

N91-12955# Technische Univ., Brunswick (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektronik.
OSCILLATIONS AND STABILITY OF A CENTRIFUGE WITH BEARING CLEARANCE Ph.D. Thesis [SCHWINGUNGEN UND STABILITAET EINER ZENTRIFUGE MIT LAGERSPIEL]
Helmut Staben 1990 129 p In GERMAN
(ETN-90-98194) Avail: NTIS HC/MF A07

The influence of radial play on the oscillations of a horizontal hanging in bearing centrifuge was calculated. The motion equations of the centrifuge model with bearing clearance which are conditioned by the machine modelization as many body system, are usual differential equations. For the model behavior, the bearing clearance was not immediately taken into account, then in linear approximation. In this connection, it caused a strong anisotropic coupling between the machine rotor and the non rotating housing. By the additional freedom of motion of the rotor in its bearings, two more proper values were added to the six ones of the backflash free model. Because of the damping in the machine housing anchoring, the proper values of both linear models were continually damped out in the considered parameter range, and the rotation of the rotor was stable. Greater out of balance forces or higher rotor speed of rotation require the solution of the nonlinear motion equations which are periodical. The stability of the T periodical solutions was examined, using the linear variational equations, according to the Floquet theory. The results were represented in stability charts. ESA

N91-12956*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EXPERIMENTAL AND ANALYTICAL EVALUATION OF EFFICIENCY OF HELICOPTER PLANETARY STAGE
Timothy L. Krantz Nov. 1990 20 p Prepared in cooperation with Army Aviation Systems Command, Cleveland, OH
(DA Proj. 1L1-6221147-A)
(NASA-TP-3063; E-5268; NAS 1.60:3063; AVSCOM-TR-90-C-001) Avail: NTIS HC/MF A03 CSCL 13I

The efficiency of a helicopter transmission planetary stage was studied both experimentally and analytically. Experiments were done by using a back-to-back, test-and-slave arrangement. The experiments were a parametric study of the effects of operating conditions on efficiency. In order to enhance the analysis, a model was developed that calculates the power required for the meshing gears to displace oil trapped between the gear teeth. In general, the analysis predicted higher efficiencies than were measured. The results of this study were compared with those of other studies. Author

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N91-12957# TubeSonics International, Inc., Norman, OK.
DEVELOP OPERATING PROTOTYPE ULTRASONIC SYSTEM BY UPDATING ENGINEERING PROTOTYPE Final Report
2 Mar. 1990 2 p
(Contract DE-FG01-87CE-15345)
(DE90-017620; DOE/CE-15345/T4) Avail: NTIS HC/MF A01

TubeSonics International Inc., was awarded a grant through the ERIP program to up-grade the technology of ultrasonic inspection equipment. The equipment to be developed was to use existing patents belonging to the principal investigator W. A. (Ben) Livingston. The equipment to be developed was to be used primarily in the inspection of the oil country tubular goods (OCTG) generally associated with both the exploration and production of fossil energy from a well bore. Products such as casing, tubing and drilling pipe are normally included in this category. The grant contemplated the completion of eight (8), major work statements. Included in these work statements were the challenge of developing a computer controlled inspection that provided real time digital data collection, evaluation and real time reporting of the engineering data. All parts of the eight (8) work statements have been completed and properly tested as of February 26, 1990. The commercial operating system will be in service on March 14, 1990. This documents discussed the details of the work statement. DOE

N91-12958# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
TIME TO FAILURE, TIME TO REPAIR AND AVAILABILITY OF A TWO-UNIT STANDBY SYSTEM WITH MARKOVIAN DEGRADING UNITS
Frank A. vanderDuynSchouten and Pieter Wartenhorst Apr. 1990 20 p
(CWI-BS-R9007; ETN-90-98071) Copyright Avail: NTIS HC/MF A03

A two unit cold standby system with Markovian degrading units and one repair facility is considered. Two types of repair are possible: preventive and corrective, where the latter is supposed to be more time consuming than the first. Repair of the units is controlled by a control limit rule. By probabilistic arguments, explicit expressions for the Laplace transforms of the time to system failure' and 'time to system repair are obtained. The steady state availability and approximations for the interval availability distribution are obtained. Iterative schemes to numerically compute the quantities derived in case of generalized Erlangian distributed repair times are presented with some numerical examples. ESA

N91-12959# Florida State Univ., Tallahassee. Dept. of Statistics.
A STUDY OF THE ROLE OF MODULES IN THE FAILURE OF SYSTEMS
Emad El-Neweihi and Jayaram Sethuraman Jul. 1990 16 p Prepared in cooperation with Illinois Univ., Chicago
(Contract DAAL03-90-G-0103; AF-AFOSR-0221-89)
(AD-A225811; FSU-TR-M829; ARO-27868.1-MA) Avail: NTIS HC/MF A03 CSCL 12/3

Since the introduction of the concept of coherent systems and the description of the reliability of such systems in terms of the reliabilities of the components, the concept of the importance of a component has created a new and fruitful area of research. In this paper we will define the role of a module (or component) that failed at the time of system failure. With this definition of role, we can summarize the work of El-Neweihi, Proschan, and Sethuraman (1978) as being mostly a study of the role of a cut set in a series-parellel system. We will refer to this paper in more detail later. The role of a module depends on the structure of the system in terms of the modules, the structure of the module in terms of its components, and the distribution of lifetimes of the components. In this paper we study the role of a module under several structures and distributions for lifetimes. We establish various monotonicity properties and indicate applications of these properties to optimal allocation. Another quantity that describes the nature of the components in sustaining the system is the number of components that fail at the time of the failure of the system. We establish monotonicity properties for the expected number of failed components and also indicate applications to optimal allocations. GRA

N91-12960# Pacific Northwest Lab., Richland, WA.
AN APPROACH TO ACQUIRING QUANTITATIVE AND QUALITATIVE KNOWLEDGE FOR FAULT DIAGNOSIS
Rex C. Stratton and Don B. Jarrell Jun. 1990 6 p Presented

at the Advances in Human Factors Research on Man-Computer Interactions: Nuclear and Beyond, Nashville, TN, 10-15 Jun. 1990 (Contracts DE-AC06-76RL-01830; NRC-FIN-B-2920) (DE90-017868; PNL-SA-17301; CONF-900607-1) Avail: NTIS HC/MF A02

Operation and maintenance activities associated with complex systems require knowledge of the physical system and knowledge of the cognitive task. This paper discusses our methodology for acquiring physical process knowledge necessary for reasoning about faults. Acquisition of process knowledge used in fault diagnosis consists of (1) problem definition, and (2) model development. Problem definition activity determines the constraints, physics, physical structure, function, and fault cases associated with the physical system. Model development activity builds knowledge models via fault-case analysis and qualitative analysis. We discuss problem definition and model development activities in context of a single-pass heat exchanger. DOE

N91-12961# Naval Postgraduate School, Monterey, CA. Dept. of Operations Research.

SEQUENTIAL ESTIMATION OF AGE REPLACEMENT POLICIES M.S. Thesis

Yang-Huang Wu Mar. 1990 64 p

(AD-A226614) Avail: NTIS HC/MF A04 CSCL 15/5

Optimal maintenance policies are designed to reduce the number of system failures and minimize the cost of repair by scheduling planned replacements. In this area the problem of updating the maintenance policy using the past maintenance history has not been adequately solved. In this thesis we study a sequential estimation procedure in a nonparametric setting to estimate the age replacement policy that minimizes long run expected maintenance costs. This thesis begins with the discussion of the concepts of preventive maintenance, age replacement policies, the settings of our simulation model, and a detailed description of the sequential estimation procedure. We include examples using actual replacement data which demonstrate the usefulness of the sequential procedure. Monte-Carlo methods are used to study the behavior of estimated optimal age replacement policy for different sample sizes, costs and underlying system life distributions. Compared with Frees and Ruppert's (1985) sequential procedure, it is competitive and for large sample sizes performs better than the Frees and Ruppert's procedure. Finally, we will introduce a graphical method to estimate the optimal age replacement policy. GRA

N91-12962*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

A PHYSICAL MODEL FOR THE ACOUSTO-ULTRASONIC METHOD Ph.D. Thesis Final Report

Michael T. Kiernan and John C. Duke, Jr. Oct. 1990 271 p (Grant NAG3-172)

(NASA-CR-185294; NAS 1.26:185294) Avail: NTIS HC/MF A12 CSCL 14D

A basic physical explanation, a model, and comments on NDE application of the acousto-ultrasonic (AU) method for composite materials are presented. The basis of this work is a set of experiments where a sending and a receiving piezoelectric transducer were both oriented normal to the surface, at different points, on aluminum plates, various composite plates, and a tapered aluminum plate. The purpose and basic idea is introduced. Also, general comments on the AU method are offered. A literature review is offered for areas pertinent, such as composite materials, wave propagation, ultrasonics, and the AU. Special emphasis is given to theory which is used later on and past experimental results that are important to the physical understanding of the AU method. The experimental set-up, procedure, and the ensuing analysis are described. The experimental results are presented in both a quantitative and qualitative manner. A physical understanding of experimental results based on elasticity solution is furnished. Modeling and applications of the AU method is discussed for composite material and general conclusions are stated. The physical model of the AU method for composite materials is offered, something which has been much needed and sorely lacking. This physical understanding is possible due to the extensive set of experimental measurements, also reported. Author

N91-13344*# Old Dominion Univ., Norfolk, VA. Dept. of Engineering Management.

DESIGN OPTIMIZATION FOR COST AND QUALITY: THE ROBUST DESIGN APPROACH

Resit Unal *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 117-118 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 14D

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N91-12963# National Inst. of Standards and Technology, Gaithersburg, MD.

STRENGTH AND CREEP-RUPTURE PROPERTIES OF ADHESIVE-BONDED EPDM JOINTS STRESSED IN PEEL

J. W. Martin, E. Embree, P. E. Stutzman, and J. A. Lechner May 1990 61 p

(PB90-257676; NIST-BSS-169) Avail: NTIS HC/MF A04; also available SOD HC $3.50 as 003-003-03009-1 CSCL 20K

The most frequently reported defect in Ethylene-Propylene-Diene terpolymer (EPDM) single-ply roofing systems is in field-formed joints. The causes of these joint defects are largely unknown, but they tend to occur a short time after a roof is installed. The main objectives were: (1) to determine the importance of the following material and fabrication variables in causing joint failures: adhesive thickness, cure time, mechanical load, adhesive type, and surface cleanness; (2) to rank these variables as they affect the creep-rupture life and strength of butyl-adhered EPDM joints; and (3) to determine the maximum peel stress which EPDM joints can sustain over their design life. From the results, cure time and level of cleanness of the EPDM membrane have no greatest effect on joint strength; while the thickness of the adhesive and the magnitude of the mechanical load have the greatest effect on the joint's creep-rupture time-to-failure. Thus the ranking of variables in creep-rupture and short-time strength experiments were different and this difference should have important implications in standards writing and in establishing performance requirements for EPDM roofing joints. GRA

N91-12964 ESDU International Ltd., London (England).

MAXIMUM INELASTIC BENDING MOMENTS AND END LOADS FOR BEAM SECTIONS OF GENERAL POLYGONAL SHAPE (COMPUTER PROGRAM) Abstract Only

Mar. 1990 64 p

(ESDU-90004; ISBN-0-85679-729-4; ISSN-0141-4097) Avail: ESDU

ESDU 90004 gives a FORTRAN program listing for calculating the combination of the pair of orthogonal bending moments and a end load, in the same ratios to each other as in an initial loading combination, that gives a defined maximum allowable extreme fiber stress or strain. The beam may be of any general solid or hollow polygonal section and the allowable stress or strain may be above the limit of proportionality of the material. The material stress/strain curve is represented by the generalized form of ESDU 76016 input to the program as an elastic modulus and either any two inelastic stress/strain values or the two characteristic values that define the generalized equation. Also required are a specification value for the 0.2 percent proof stress and the ultimate tensile strength. The program gives the location of the neutral axis, the radius of curvature of the deflected beam, and the stress

and strain at each vertex under the maximum loads. Corresponding data for an elastic solution with the 0.2 percent proof stress at the extreme fiber are also output. Additionally, values are given for the cross-sectional area, the second moment of area, and the position of the centroid. An option allows the beam to be constrained in one direction when the output will be the maximum moment in the other direction and end load in the same ration as the input, together with the value of the restraining moment. The program assumes a linear strain distribution under the action of the moment, with a nonlinear stress variation, and that plane sections remain plane. No account is taken of any instability and it is assumed loads are applied simultaneously maintaining their ratios. The input and output formats are fully explained through worked examples (one polygon), and the testing and validation of the program are discussed. The program is available on magnetic media as ESDUpac 9004. ESDU

N91-12965 ESDU International Ltd., London (England).
PARAMETER ESTIMATION OF LINEAR SYSTEMS FROM FREQUENCY RESPONSE MEASUREMENTS Abstract Only
May 1990 33 p
(ESDU-90006; ISBN-0-85679-731-6; ISSN-0141-3988) Avail: ESDU

It is assumed that the system is modelled as a set of coupled second-order differential equations with constant coefficients, and that a set of frequency response data is available from forced harmonic excitation of the system over a frequency range that encompasses its resonant modes. For systems all of whose response modes are lightly damped (damping ratios less than 0.2), a method is given for estimating from a Nyquist plot of the frequency response the natural undamped frequencies and damping ratios of all modes, even those whose resonant frequencies are close together. From those system characteristics, a sufficient number of initial estimates of the unknown parameters can be evaluated to provide initial values for an interactive parameter estimation procedure. An objective function is formed from the sum of the squares of the differences between measurements and model predictions and is minimized with respect to each parameter in turn. The set of non-linear equations that results is solved iteratively by the Newton-Gauss procedure. A worked example using a two-degree-of-freedom coupled system illustrates the use of the technique. ESDU

N91-12966 ESDU International Ltd., London (England).
FATIGUE OF ALUMINUM ALLOY JOINTS WITH VARIOUS FASTENER SYSTEMS Abstract Only
Jun. 1990 30 p
(ESDU-90009; ISBN-0-85679-735-9; ISSN-0958-0379) Avail: ESDU

ESDU 90009 presents the results of over 350 axial load fatigue tests extracted from the literature on the joints under variable amplitude loading (mainly the FALSTAFF loading sequence although the TWIST sequence was used for a few tests). A medium load transfer joint is one in which between 10 and 30 percent of the axial load is transferred between members, and many chordwise and spanwise joints in aircraft wings fall in that category. Three fastener types are included, assembled with a range of fits from clearance to high interference and with three different interfays. Other factors examined were fastener size, head type (either countersunk or protruding) and material (either titanium alloy or steel). Two plate thicknesses were used. Details of the alloys (DTD 5120, BS L93, 7475-T7351 and 2024-T351) and of the test specimens are included and the influence of the various variables on the fatigue strength is discussed. Included are data for joints manufactured with a corner crack in the fastener hole; these tests were designed to investigate a repair in which the hole was drilled out but insufficiently to eliminate an existing crack. It is noted that, due to the unequal load distribution from the different stiffnesses of the joined members along adjacent parts of their length, the joints were subjected to bending. The values of this secondary bending could not be determined and no account of it could be taken in the analysis and presentation of the data. ESDU

N91-12967# Ames Lab., IA.
CHARACTERIZING CLOSURE ASPERITIES BY ULTRASONIC MEASUREMENTS
R. B. Thompson, L. VanWyk, D. K. Rehbein, Y. M. Tsai, and O. Buck 1989 10 p Presented at the 7th International Conference on Fracture (ICF-7), Houston, TX, 20-24 Mar. 1989 Previously announced in IAA as A90-41429
(Contract W-7405-eng-82)
(DE90-016709; IS-M-631; CONF-890310-6) Avail: NTIS HC/MF A02

It has recently been shown that considerable information about the topology of contacting asperities on the faces of fatigue cracks can be obtained from ultrasonic measurements. The particular configuration of interest is that of a fatigue crack in a compact tension specimen, illuminated at normal incidence by a longitudinal elastic wave. Previous work has suggested that the number density and dimensions of the contacts can be deduced from measurements of the frequency and spatial variations of the scattered elastic wave fields. An analysis of the spatial Fourier transform of the dynamic crack opening displacement is used to interpret those conclusions and analyze several recent experimental results. DOE

N91-12968 Utah Univ., Salt Lake City.
IMPACT RESPONSE OF CARBON/EPOXY LAMINATED PLATES Ph.D. Thesis
Yibo Qian 1990 202 p
Avail: Univ. Microfilms Order No. DA9024428

Appropriate scaling rules are established for structural response and damage of laminated plates. The theory of similarity is applied to the governing differential equations of laminated plates under impact loading to derive the linear scaling rules. A fracture mechanics analysis is carried out to develop the delamination scaling rule. Impact tests were performed on AS4/3501-6 carbon/epoxy laminated plates to evaluate the accuracy of these scaling rules. It is found that the measured strain responses at constant impact velocity are the same with time scaling and the magnitudes of the strains are linearly proportional to impact velocity. The results accurately follow the linear scaling rules. The second aspect of this dissertation is to develop a bending dominated, shear deformable model for both quantitative predictions of structural response in impacted laminate plates and parametric analyses of the problem. A Rayleigh-Ritz energy method using beam functions for assumed plate deflections is employed to spatially discretize the time varying boundary problem. Newmark implicit integration in time is used to solve the resulting second order, ordinary differential equations. The effects of nonlinear contact deformation, contact area, transverse shear deformation, and bending-twisting coupling are considered. The Rayleigh-Ritz approach can be applied to impact of plates with boundary conditions other than simply-supported or clamped on all four edges. The use of the contact stiffness as well as the contact area eliminates the singularity in strains and shear forces predicted behind impact point for a point load. By satisfying the equilibrium equations, the transverse shear stresses and shear forces are obtained by integrating the derivatives of in-plane stresses in the laminate thickness direction. Dissert. Abstr.

N91-12969# Army Armament Research, Development and Engineering Center, Watervliet, NY.
A PLANE-STRAIN ELASTIC STRESS SOLUTION FOR A MULTIORTHOTROPIC-LAYERED CYLINDER Final Report
Mark D. Witherell Jun. 1990 31 p
(AD-A225000; ARCCB-TR-90016) Avail: NTIS HC/MF A03
CSCL 20/11

In 1963 Lekhnitskii published the equations that describe the distribution of stresses in a monolayered anisotropic cylinder under the influence of various loading conditions. Recently, O'Hara simplified these equations for the case of an orthotropic cylinder and cast them into a form that is convenient to use. This report discusses the methodology of constructing the stress solution for a multiorthotropic-layered cylinder under plane-strain boundary conditions, i.e., all orthotropic layers have zero axial strain.

Combined loadings of internal and external pressure are allowed. Solutions for a selected layup and loading conditions are compared with finite element results and show excellent agreement. In addition, a procedure to obtain the stress solution when an interference exists at the interface of two orthotropic layers is discussed. GRA

N91-12970# Helsinki Univ. of Technology, Espoo (Finland).
BLAST VIBRATION: THRESHOLD VALUES AND VIBRATION CONTROL Ph.D. Thesis
Raimo Vuolio (Oy Finnrock A.B., Helsinki, Finland) Finnish Academy of Technology 1990 150 p
(Ci-95; ISBN-951-666-301; ISSN-0355-2705; ETN-90-97977)
Avail: NTIS HC/MF A07

A proposal for Finnish blast vibration standards and a calculation model for the extent of the zones for building inspection, risk analysis, and vibration measurements are given. The international conclusion is that particle velocity is the best description for limiting damage potential for structures. The data collected during 1970 to 1989 shows that the most practical description is the vertical component of the peak particle velocity. As rock is a nonhomogeneous medium, it is hard to predict the need and scope of risk analyses, building inspection, and vibration measurements. As a large number of blasts was monitored for the recording of the peak particle velocity in several locations in Finland, and the data was combined, it is possible to establish safe scaled distances for the calculation of the need and scope of risk analysis, building inspection, and vibration measurements. ESA

N91-12971*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DESIGN AND FABRICATION OF INSTRUMENTED COMPOSITE AIRFOILS FOR A CRYOGENIC WIND TUNNEL MODEL
Clarence P. Young, Jr., George C. Firth, William H. Hollingsworth, Jr., Bruce M. Adderholdt, and Barry V. Gibbens Oct. 1990 28 p
(NASA-TM-102740; NAS 1.15:102740) Avail: NTIS HC/MF A03 CSCL 20K

Two instrumented horizontal stabilizers and one instrumented vertical stabilizer were designed and fabricated for testing on the Pathfinder 1 (PF-1) Transport Model in the NASA Langley Research Center's National Transonic Facility (NTF). Two different designs were employed: the horizontal stabilizer utilized a metal spar and fiberglass overwrap and the vertical stabilizer was made of all fiberglass. All design requirements were met in terms of design loads, airfoil tolerances, surface finish, orifice hole quality, and proof-of-concept tests. Pressure tubing installation was found to be easier for these concepts as compared to methods used in conventional metallic models. Ease of repair was found to be a principal advantage in that some fabrication problems were overcome by reapplying fiberglass cloth and/or epoxy to damaged areas. Also, fabrication costs were judged to be lower when compared to the more conventional design fabrication costs. Author

N91-12972# Army Materials Technology Lab., Watertown, MA. Materials Dynamics Branch.
THE APPLICATION OF LASER SPECKLE INTERFEROMETRY TO MEASURE STRAIN AT ELEVATED TEMPERATURES AND VARIOUS LOADING RATES Final Report
John L. Green, James F. Emslie, and Shun-Chin Chou May 1990 24 p Sponsored by Army Lab. Command, Adelphi, MD
(AD-A225583; MTL-TR-90-23) Avail: NTIS HC/MF A03 CSCL 20/11

This report investigates the application of speckle interferometry for the measurement of strain when a material is subjected to various loading rates and elevated temperature conditions. The Medium Strain Rate Facility at the U.S. Army Materials Technology Laboratory was used to conduct uniaxial tension tests at strain rates of .00001/sec to .1/sec, temperatures up to 250 F and heating rates of 250 F/sec. Strain was measured by laser speckle interferometry technique and strain gages, the results of both methods were compared. Laser speckle interferometry was also used for the measurement of strain at large deformation, i.e., necking region of tensile specimens. The laser speckle interferometry results are in agreement with strain gage results at strain rates up to .1/sec for temperatures up to 250 F. This investigation also indicated laser speckle interferometry would be an excellent noncontact localized strain measuring device for adverse conditions if the following drawbacks were overcome. When using the ruby laser system, only one stress-strain data point can be obtained, the present system is not suited for strain rates over .1/sec and no results can be obtained if the specimen is heated to a point that it begins to emit intense red light. The shortcomings of laser speckle interferometry could be overcome by using another laser and data acquisition system. GRA

N91-12973# Army Missile Command, Redstone Arsenal, AL. Aeroballistics Analysis Branch.
THE RELEVANCE OF THE DE BROGLIE RELATION TO THE HUGONIOT ELASTIC LIMIT (HEL) OF SHOCK LOADED SOLID MATERIALS Final Technical Report, Jul. - Dec. 1989
James P. Billingsley and James M. Oliver Mar. 1990 27 p
(AD-A225786; AD-E951508; AMSMI/TR-RD-SS-90-4) Avail: NTIS HC/MF A03 CSCL 20/11

Under moderate shock loading (a few kilobars) where elastic-plastic shock phenomena (EPSP) occur in solid materials, two stress waves are created. The first one is essentially an elastic wave and has become known as the Hugoniot elastic limit (HEL). The HEL particle velocity, Up HEL, can be closely related to the De Broglie particle momentum wave velocity, V1 = h/(2md1), where, h is Planck's constant, m is the mass of an atom, and d1 is the closest distance between atoms in the structure. Classic EPSP test data for iron, aluminum alloys (2024, 6061), and pressed TNT are compared to computed values of V1 and 2V1. Qualitative remarks with respect to particle stability are made which are based primarily on Fitzgerald's analysis(17). Author (GRA)

N91-12974# R and D Associates, Alexandria, VA.
MODELING THE DYNAMIC LOAD/UNLOAD BEHAVIOR OF CERAMICS UNDER IMPACT LOADING Final Report
J. R. Furlong, M. L. Alme, and J. F. Davis Jul. 1990 58 p
(Contract DAAL03-89-C-0019)
(AD-A225999; RDA-TR-0030-0001-001; ARO-27116.1-MS-A)
Avail: NTIS HC/MF A04 CSCL 11/2

The RDA ceramic failure model was used to model the behavior SiC and B4C during plate impact loading. The experiments modeled were performed at Sandia National Laboratory. The simulations were performed with a version of the Sandia WONDY-V hydrocode that was modified to run on a PC and to include the RDA ceramic failure model. The model adequately characterizes the two ceramic materials although B4C and SiC exhibit distinctly different degrees of work hardening, strain rate hardening, and damage sensitivity. Both materials experienced damaged (micro-making) on load which was predicted by the model. The experimental unloading data exhibits a reduced magnitude elastic unload wave which suggests that further damage has accumulated after the ceramic reaches peak stress. A strength reducing mechanism such as fatigue, or melting at grain boundaries are suspected as the cause of this unpredicted strength loss. No spall was evident in the measured signals and the model predicts spall will not occur. The predicted axial stress levels were significantly above the estimated spall strengths of the two ceramics. Failure was prevented by positive (compressive) mean stress levels that were maintained throughout the ceramic specimen during the experimental measurement. Therefore, a suggested conclusion is that for tensile failure to occur in these ceramics, the mean stress must be negative (tensile). GRA

N91-12975# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
IMPLICATIONS OF VISCOSITY AND STRAIN GRADIENT EFFECTS FOR THE KINETICS OF PROPAGATING PHASE BOUNDARIES IN SOLIDS
Rohan Abeyaratne and James K. Knowles (California Inst. of Tech.,

Pasadena.) Apr. 1990 39 p
(Contract N00014-87-K-0117)
(AD-A226120; TR-11) Avail: NTIS HC/MF A03 CSCL 20/11

This paper is concerned with the propagation of phase boundaries in elastic bars. It is known that the Riemann problem for an elastic bar capable of undergoing isothermal phase transitions need not have a unique solution, even in the presence of the requirement that the entropy of any particle cannot decrease upon crossing a phase boundary. For a special class of elastic materials, we have shown elsewhere that, if all phase boundaries move subsonically with respect to both phases, this lack of uniqueness can be resolved by imposing a nucleation criterion and a kinetic relation relation for the relevant phase transition. Here we investigate an alternative approach that singles out acceptable solutions on the basis of a theory that adds effects due to viscosity and second strain gradient to the elastic part of the stress. We show that, for phase boundaries that propagate subsonically, this approach is equivalent to the imposition of a particular relation at the interface between the phases. GRA

N91-12976# David Taylor Research Center, Bethesda, MD. Dept. of Ship Materials Engineering.
PROCEDURE FOR A DROP TOWER TESTING OF SHALLOW CRACKED SINGLE EDGE NOTCHED BAND SPECIMENS Research and Development Report, Jun. 1989 - Feb. 1990
M. T. Kirk, J. P. Waskey, and R. H. Dodds, Jr. Jul. 1990 54 p
(Contract N61533-88-C-0035)
(AD-A226382; DTRC-SME-90/18) Avail: NTIS HC/MF A04 CSCL 20/11

Underprediction of the reserve capacity of structures against fracture often result from use of conventional initiation fracture toughness values measured using deeply cracked bend specimens. Conversely, favorable comparisons between prediction and structural fracture behavior are reported when predictions are based on toughness values measured so that the crack tip constraint and loading rate closely match those experienced in service. Thus, considerable attention has been paid to elevated fracture initiation resistance of cracks shallower than the 0.45 to 0.75 a/W used in standardized tests. However, standard procedures for estimating fracture initiation resistance of shallow cracks, particularly at the high loading rates characteristic of certain severe service conditions, have yet to be developed. Techniques useful for estimating the load, load line displacement and onset of crack extension during impact tests of single edge notched bend specimens having shallow fatigue cracks (a/W = approx. 0.1) were developed and validated. Bending stress distribution across the specimen midway between the support and loading points, determined based on strain measurements and a uniaxial stress-strain relationship, was used to estimate the load imparted to the specimen by the impactor. Load line displacement was estimated using four non-contacting transducers positioned along the underside of the bend specimen while onset of crack extension was inferred from strain readings taken from the elastically loaded region behind the fatigue crack tip. GRA

N91-12977# Sandia National Labs., Albuquerque, NM.
DYNAMIC YIELD STRENGTH AND SPALL STRENGTH MEASUREMENTS UNDER QUASI-ISENTROPIC LOADING
L. C. Chhabildas and J. R. Asay 1990 9 p Presented at the Explomet Conference, San Diego, CA, 12-17 Aug. 1990
(Contract DE-AC04-76DP-00789)
(DE90-016105; SAND-90-0883C; CONF-9008125-3) Avail: NTIS HC/MF A02

In this paper, measurements on the quasi-isentropic compression of tantalum and tungsten to stress levels of 60 GPa and 250 GPa, respectively, are reported. Results of these experiments have been compared to those obtained under shock loading conditions. These experiments have allowed the determination of temperature, pressure, and loading effects on the dynamic yield strength of tungsten and tantalum up to 250 GPa and 80 GPa, respectively. The results show that the dynamic yield strength of tungsten is dependent on the loading rate with the strength being higher for the slower rates of loading along the quasi-isentrope. The pressure dependence of the yield strength of tungsten is determined nearly independent of temperature effects from quasi-isentropic loading experiments to 250 GPa, because the temperature rise in an quasi-isentropic loading experiment is much lower than that associated with shock loading experiments. For tantalum, quasi-isentropic loading experiments up to 60 GPa suggest that the dynamic yield strength is comparable to that determine under shock loading conditions up to 50 GPa. There is significant decrease in the dynamic yield strength for tantalum above 50 GPa under shock loading. A determination of spall strength for tantalum precompressed to 60 GPa under quasi-isentropic loading suggests an increase in spall strength when compared to the strength measurements in a shocked specimen at 20 GPa. DOE

N91-12978# Lawrence Livermore National Lab., CA.
NONDESTRUCTIVE EVALUATION OF RESIDUAL STRESS IN ANISOTROPIC MATERIALS Final Report
George C. Johnson (California Univ., Berkeley.) May 1990 21 p
(Contract W-7405-eng-48)
(DE91-000952; UCRL-CR-104838) Avail: NTIS HC/MF A03

The specific focus on anisotropic materials in the research was addressed in a manner which was primarily analytical. All of the experiments involving materials with substantial elastic or plastic anisotropy indicated that the materials in question exhibited a level of acoustoelastic response which was at or below the limit for useful stress evaluation. Nevertheless, the analysis performed indicates that if an experimental system is built which allows determination of the velocity variation roughly an order of magnitude more precisely than is possible with the system used in this work, the complete state of residual stress may be obtained, despite the presence of anisotropy. A detailed description of the technique and experimental system proposed for the evaluation of residual stress states is presented. The underlying analytical developments are reviewed, and a numerical investigation into the application of this approach for anisotropic materials is presented. It is shown that an accurate assessment of the complete residual stress state may be obtained even in cases of extreme anisotropy. Finally, an experimental investigation of the technique is presented in which the experimentally determined stress state is compared with that predicted numerically. It is shown that the two estimates of stress agree well for the material involved. DOE

N91-12979# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
MICROMECHANISMS OF BRITTLE FRACTURE: ACOUSTIC EMISSIONS AND ELECTRON CHANNELING ANALYSES
William W. Gerberich Jun. 1990 11 p
(Contract DE-FG02-84ER-45141)
(DE91-000987; DOE/ER-45141/T5) Avail: NTIS HC/MF A03

The objectives of this work are to: (1) Evaluate the initial stages of cleavage nucleation in single and polycrystalline samples; (2) Determine the controlling event(s) which lead(s) to unstable cleavage (is it an unstable cluster of microcracks or a crack-tip opening displacement criterion for an array of ligaments surrounding these microcracks); (3) Determine how the process zone, which depends upon microstructure and processing history, affects the controlling event(s); (4) Use Selected Area Channeling Patterns (SACP's) to assist in an independent measure of the cleavage fracture stress of grains cleaved at or just outside the elastic-plastic boundary; also, use it to evaluate static and dynamic strain distributions; and (5) Evaluate the effects of dislocation shielding and overload using combined methods of computational mechanics with discretized dislocation arrays and direct observations of dislocations using channeling, etch pit and birefringence methods. Accomplishments are discussed. DOE

N91-12980*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STIRLING ENGINE: AVAILABLE TOOLS FOR LONG-LIFE ASSESSMENT
Gary R. Halford and Paul A. Bartolotta 1991 7 p Presented

at the 8th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 6-10 Jan. 1991; sponsored by NASA, New Mexico Univ., Strategic Defense Initiative Organization, DOE, and AF
(NASA-TM-103660; E-5856; NAS 1.15:103660) Avail: NTIS HC/MF A02 CSCL 20K

A review is presented for the durability approaches applicable to long-time life assessment of Stirling engine hot-section components. The crucial elements are experimental techniques for generating long-time materials property data (both monotonic and cyclic flow and failure properties); analytic representations of slow strain rate material stress-strain response characteristics (monotonic and cyclic constitutive relations) at high temperatures and low stresses and strains; analytic creep-fatigue-environmental interaction life prediction methods applicable to long lifetimes at high temperatures and small stresses and strains; and experimental verification of life predictions. Long-lifetime design criteria for materials of interest are woefully lacking. Designing against failures due to creep, creep-rupture, fatigue, environmental attack, and creep-fatigue-environmental interaction will require considerable extrapolation. Viscoplastic constitutive models and time-temperature parameters will have to be calibrated for the hot-section materials of interest. Analysis combined with limited verification testing in a short-time regime will be required to build confidence in long-lifetime durability models. Author

N91-12981# Institut Franco-Allemand de Recherches, Saint-Louis (France).
UTILIZATION OF DYNAMIC CRUSHING TESTS IN DIGITAL SIMULATIONS [DIE VERWENDUNG VON AUFSTAUCHVERSUCHEN IN DER NUMERISCHEN SIMULATION]
G. Paulus 31 Dec. 1988 50 p In GERMAN Presented at Carl-Cranz-Gesellschaft-Kurs B1.39 Probleme der numerischen Simulation extremdynamischer Vorgaenge in der Endballistik, Weil am Rhein, Fed. Republic of Germany, 5-8 Dec. 1988 Original contains color illustrations
(ISL-CO-257/88; ETN-90-98026) Avail: NTIS HC/MF A03

The applications of the crushing tests in digital simulation are described. Codes with finite elements and equation of the propagation of elastic waves in a bar are compared. The possibilities of mesh and the influence of the parameters are discussed as well as the conditions for the use of the Taylor formula and the evaluation of the maximal stresses. A process for the determination of the material characteristics in the models of digital simulations is given as a conclusion. ESA

N91-12982# Institut Franco-Allemand de Recherches, Saint-Louis (France).
OPTIMIZATION OF DIGITAL MODELS FOR THE DESCRIPTION OF THE DYNAMIC BEHAVIOR OF MATERIALS [OPTIMIERUNG VON COMPUTER-MODELLEN ZUR BESCHREIBUNG DES DYNAMISCHEN MATERIALVERHALTENS]
R. Hunkler 29 Dec. 1988 37 p In GERMAN Presented at Carl-Cranz-Gesellschaft Lehrgang B1.39 Probleme der Numerischen Extremdynamischer Vorgaenge in der Endballistik, Weil am Rhein, Fed. Republic of Germany, 5-8 Dec. 1989
(ISL-CO-258/88; ETN-90-98027) Avail: NTIS HC/MF A03

The material dependent parameters used in the hammer hardening model of Johnson-Cook are determined to obtain an optimal agreement between the data from terminal ballistic experiments and the simulation. Crushing tests were simulated and the calculated final contour of the projectile was compared with the observations. By variation of the parameter values, the calculated contour was fitted to the measurement contour by means of the optimization program. As examples, projectiles made of electrolytic copper and heavy metal were examined. ESA

N91-12983# Oxford Univ. (England). Dept. of Engineering Science.
THE GENERAL FORM OF THE AIRY STRESS FUNCTION
J. D. Renton 1990 10 p
(OUEL-1837/90; ETN-90-98225) Avail: NTIS HC/MF A02

By casting the Airy stress function relationship in general terms, the expressions for stress in any coordinate system can be found. Cartesian and polar coordinate systems are then just two particular cases of the general result. Although tensor notation is used, the results for orthogonal coordinate systems are expressed in terms of the more familiar 'physical components' of stress. Examples which use elliptic-hyperbolic, parabolic and bipolar coordinates are given. ESA

N91-12984# Helsinki Univ. of Technology, Espoo (Finland). Faculty of Civil Engineering and Surveying.
A STUDY OF CURVED THIN-WALLED GIRDERS Ph.D. Thesis
Juha Paavola Finnish Academy of Technology Feb. 1990 94 p Sponsored by Finnish Foundation of Technology, and Emil Aaltonen Foundation
(Ci-94; ISBN-951-666-299-4; ISSN-0355-2705; ETN-90-98231)
Avail: NTIS HC/MF A05

The numerical model for analyzing thin walled girders is developed. The linear elastic material model and the theory of infinitesimal displacements and strains are adopted. The method is based on a further development of the conventional idea for torsion of thin walled girders with a closed cross section and is combined with the finite element method. Economical aspects often support developing these kinds of coalitions, taking into account the special nature and properties of structures of this type, to reduce the size of the computational model required. Numerical comparisons showing good agreement with other results are presented. ESA

N91-13346*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
ANALYSES OF COMPOSITE FUSELAGE STRUCTURE UNDER VARIOUS LOADING CONDITIONS
Fuh-Gwo Yuan *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 123-125 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20K

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N91-12985# Beleidscommissie Remote Sensing, Delft (Netherlands).
ANALYSIS OF THE OCTOBER 1984 L-BAND DUTSCAT SCATTEROMETER DATA
P. J. F. Swart (Technische Univ., Delft, Netherlands) Feb. 1990 64 p
(BCRS Proj. 4543/AO-2.9)
(BCRS-89-40; ETN-90-97689) Avail: NTIS HC/MF A04

The analysis of multi-angular L-band HH-polarization data acquired with a prototype of the airborne scatterometer DUTSCAT is described. The objective was to test the inverse use of a scatter model for bare soil. The inverse scattering experiment aims at the extraction of parameters, that described soil moisture content and

roughness, from radar data supported by simultaneously collected ground data. A semi-empirical bare soil scatter model based on partially coherent scattering is used to provide a first link between radar and ground data. Possible vegetation influences are neglected and cases where it is obvious that they are not neglectable, are excluded. An important part of this report is dedicated to the description of the DUTSCAT data processing and results. Major steps are the radiometric correction using flight and system parameters, video/fieldboundary time-synchronization (needed because DUTSCAT is not an imaging radar), and along-track field averaging. ESA

N91-12986# Beleidscommissie Remote Sensing, Delft (Netherlands).
TOPOGRAPHIC MAPPING FROM SPOT SATELLITE IMAGERY Thesis - Technische Univ. Delft
Daan vanderHoeven Apr. 1990 158 p Prepared in cooperation with KLM Aerocarto, Schiphol, Netherlands
(BCRS-90-06; ETN-90-97692) Avail: NTIS HC/MF A08

The topographic mapping capabilities of imagery from SPOT satellite are investigated. An overview of the SPOT satellite systems and products are given. The main goal of research was to realize an operational environment capable of stereo plotting from SPOT imagery and to investigate to what extent SPOT imagery can compete with aerial photography for topographic mapping purposes at scale 1:50,000. In order to test the information content and interpretability, an 8 by 8 sq km test area was digitized and plotted to conform to 1:50,000 specifications. This map was compared with recent aerial photography of the same area. It turned out that main infrastructural details can be identified but that there may be a deterioration of interpretation correctness and completeness when smaller features are concerned. An overview of other Earth observing systems is given. The SPOT mapping costs are investigated. The automated production of digital elevation models from SPOT digital data is described. ESA

N91-12987# Beleidscommissie Remote Sensing, Delft (Netherlands).
HIGH AND LOW RESOLUTION SATELLITE IMAGES TO MONITOR AGRICULTURAL LAND
S. M. L. Azzali (Winand Staring Centre, Wageningen, Netherlands) Apr. 1990 79 p
(BCRS-90-07; ISSN-0924-3062; ETN-90-97693) Copyright Avail: NTIS HC/MF A05

The evaluation of feasible methods to improve the real time information on the agricultural production presented as one aspect of the MARS (Monitoring Agro-ecological resources by means of Remote sensing and Simulation) project in Zambia. Remote sensing images, a geographical information system, and an implementation of a numerical simulation model based on crop growth are used. The combination of satellite data, meteorological data, literature information, and maps was used. A synergistic effect to understand the considered agricultural scenarios was shown. The results obtained to assess agricultural production are discussed. ESA

N91-12988# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SYSTEM FOR OBTAINING THE VEGETATIVE INDEX OF SOUTH AMERICA BY DIGITAL PROCESSING OF NOAA/AVHRR IMAGERY M.S. Thesis [SISTEMA DE OBTENCAO DE INDICE DE VEGETACAO PARA AMERICA DO SUL POR PROCESSAMENTO DIGITAL DE IMAGENS NOAA/AVHRR]
Divino Cristino deFigueiredo Apr. 1990 99 p In PORTUGUESE; ENGLISH summary
(INPE-5068-TDL/407) Avail: NTIS HC/MF A05

The purpose was to develop software to obtain Vegetation Index products for South America through images of NOAA polar orbiting satellites, using the SITIM image processing equipment. Input data are the AVHRR sensor images in the visible (0.58 to 0.68 microns) and near-infrared (0.72 to 1.1 microns) spectral bands with 1.1 km spatial resolution received by INPE/Cachoeira Paulista, SP, and also the corresponding orbital parameters of the NOAA satellites. The following final products were produced: a digital Normalized Difference Vegetative Index - NDVI mosaic image with 1020 x 1024 pixels and a 5 km spatial resolution covering the continent between 0 and 45 degrees South and 32 and 77 degrees West over a period of 15 days; and graphs showing temporal variations and listings of NDVI for places of navigation (finding geographical coordinates for NOAA/AVHRR image pixels) and inverse navigation (opposite calculation), for production of digital mosaic images, for combining images and maps with political boundaries, and producing NDVI for areas of interest. Structured analysis technique was used to support the software development. The results, considered as tests with 1988 images, indicated that the objective of this work was accomplished. Other useful AVHRR applications based on the navigation software can also be derived, such as biomass burning, sea surface temperature, and cloud monitoring. Considering the current use of the SITIM in Brazil, it is possible that this work will have numerous uses in the near future for regional and continent studies. Author

N91-12989# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PHYSIOGNOMY OF VEGETATION COVER IN THE PANTANAL MATO GROSSINA NATIONAL PARK: A TEMPORAL ANALYSIS [A FISIONOMIA DA COBERTURA VEGETAL DO PARQUE NACIONAL DO PANTANAL MATO GROSSENSE: UMA ANALISE TEMPORAL]
Flavio Jorge Ponzoni, Pedro HernandezFilho, Marisa Terezinha Pereira, and Cirineu Jorge Lorensi May 1989 85 p In PORTUGUESE; ENGLISH summary
(INPE-4809-RPE/589) Avail: NTIS HC/MF A05

TM/LANDSAT and 35 mm aerial photography were utilized in the physiognomic mapping of Pantanal Mato-Grossence National Park vegetation cover. Two seasonal periods - dry and wet - were considered in the evaluation of the constraints and opportunities of these products in order to choose the vegetation classification system which could be applied in similar PNPM environments. Through both visual interpretation and digital processing the water level variation and influence in the vegetation physiognomies identified were quantified. Author

N91-12990# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF DIGITAL PROCESSING TECHNIQUES OF TM/LANDSAT IMAGERY APPLIED TO URBAN AREA DEMARCATION M.S. Thesis [AVALIACAO DE TECNICAS DE PROCESSAMENTO DIGITAL DE IMAGENS TM-LANDSAT APLICADAS A DELIMITACAO DE AREAS URBANAS]
Sandra Maria FonsecadaCosta Apr. 1990 122 p In PORTUGUESE; ENGLISH summary
(INPE-5071-TDL/410) Avail: NTIS HC/MF A06

Orbital remote sensing can be used to help urban studies, owing to the possibility of obtaining images of regional ambit and quasi-real time information, allowing limit definition and urban monitoring. Thematic Mapper (TM) data, in CCT, of Sao Jose dos Campos City, Sao Paulo State, was used to: (1) identify the best band of TM sensor, through JM distance, in the separability between the urban and non-urban areas; and (2) select, through Kappa statistics, among the digital processing techniques, contrast-stretch, channel ratio, vegetation index, and principal components, the one that best defines the urban limits. The dry season and the wet season were analyzed. The results obtained proved that band 1, in the dry season, and band 3, in the wet season, had the best performance in the separability of urban/non-urban categories. The principal components technique presented the greatest values of agreement with the standard image in definition of the urban limit. Author

N91-12991# Arnold Engineering Development Center, Arnold Air Force Station, TN.
INFRARED SURFACE TEMPERATURE MEASUREMENTS IN THE PRESENCE OF REFLECTED RADIATION Final Report, Oct. 1988 - Sep. 1989
A. G. Jackson (Sverdrup Technology, Inc., Arnold AFS, TN.) Aug.

1990 52 p
(AD-A225660; AEDC-TR-90-12) Avail: NTIS HC/MF A04
CSCL 20/13

A method is described for determining surface temperature in the presence of radiation being reflected by the surface of interest from another nearby hot surface. Radiance measurements are made on the surface of interest and on the nearby hot object in three different wavelength bands (three colors). If the emittance of the target surface varies significantly with wavelength, it is necessary to know the ratios of emittances in the three wavelength bands. An experiment was performed to demonstrate the three-color technique, and results are reported. The three-color technique was shown to be highly sensitive to non-gray behavior. Application of the three-color technique with corrections for non-gray behavior resulted in temperature measurement errors less than 2 percent in the presence of reflected radiation. Conventional ratio pyrometry (two colors) resulted in errors greater than 10 percent in the presence of reflected radiation. GRA

N91-12992# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Fernerkundungsanwendungen.

PROCEEDINGS OF THE 6TH USER SEMINAR OF THE GERMAN REMOTE SENSING DATA CENTER OF THE DLR

Mar. 1990 94 p In GERMAN; ENGLISH summary Seminar held in Oberpfaffenhofen, Fed. Republic ofGermany, 18-19 Sep. 1989 Report will also be announced as translation (ESA-TT-1245) Original contains color illustrations
(DLR-Mitt-90-09; ISSN-0176-7739; ETN-90-98047) Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

Papers on the application potential of data from NOAA, LANDSAT and the ERS-1 satellites, with main emphasis on the processing and application of radar data are presented. Results of applications in botany, hydrology and geology are also outlined. Remote sensing in developing countries, data distribution, and the Japanese MOS-1 satellite are discussed. For individual titles, see N91-12993 through N91-13005.

N91-12993# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Angewandte Datentechnik.

ERS-1: THE FIRST EUROPEAN REMOTE SENSING SATELLITE. A PAYLOAD MISSION, GROUND STATION, STANDARD PRODUCTS, AND USER SERVICE OUTLINE [DER ERSTE EUROPAEISCHE FERNERKUNDUNGSSATELLIT ERS-1. EINE UEBERSICHT UEBER NUTZLASTE UND MISSION, BODENSEGMENT, STANDARDPRODUKTE UND NUTZERSERVICE]

Joerg Gredel *In its* Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 11-20 In GERMAN (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

ERS-1 active and passive sensors are presented. The ground station is represented under the form of a distributed processing system diagram to be used by ESA and its member countries. Ground stations for sensor data recording developed a general network for data terminal and data recording. Processing and Archiving Facilities (PAF's) were built to carry out the processing and filing of ERS-1 sensor data and distribute the processed data among users. As a result of several studies, in which the technical possibilities of ERS-1 data terminal in Antartica and the user requirements were examined, it was decided to create a station for the reception of ERS-1 Synthetic Aperture Radar (SAR) data and for the interferometric measurement of plate tectonics. ESA

N91-12994# Deutsche Gesellschaft fuer Technische Zusammenarbeit, Eschborn (Germany, F.R.). Abt. 404 Sektoruebergreifende Programme.

REMOTE SENSING APPLICATIONS IN THE FRAMEWORK OF THE COOPERATION WITH DEVELOPING COUNTRIES [EINSATZ DER FERNERKUNDUNG IM RAHMEN DER TECHNISCHEN ZUSAMMENARBEIT MIT ENTWICKLUNGSLAENDERN]

Reinhold Baeuerle *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 21-25 In GERMAN (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

Out of more than two thousand projects of technical cooperation in more than a hundred third-world countries, an inquiry showed that satellite remote sensing was mentioned in more than thirty projects (distributed in twenty-five countries). Application fields were hydrology, forestry, regional planning and development, erosion protection, desertification control, and mapping. Two different types of projects are presented as examples: the design of maps for a region in Chad, and the promotion of the National Remote Sensing Facility (NRSF) in Zimbabwe. ESA

N91-12995# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

EARTH OBSERVATION DATA SERVICE (EDS) [ERDERKUNDUNGS-DATEN-SERVICE (EDS)]

Dieter Gottschalk *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 27-29 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

A new field of activity consisting of selling image data of an operational Earth observation satellite is described. With the EDS (German acronym for Earth observation data service), progress was made in Germany towards such a marketing activity. The companies engaged in this field are convinced that satellite Earth observation will reach an increasing importance for present and future business employment. The recent experience showed that the information of the user on the data application possibilities, and a simple and rapid data access are of decisive importance. ESA

N91-12996# Joanneum Research Centre, Graz (Austria). Inst. fuer Digitale Bildverarbeitung und Graphik.

GEOLOGICAL APPLICATIONS OF SPACE SAR DATA [GEOLOGISCHE ANWENDUNGEN VON WELTRAUM-SAR-DATEN]

Manfred F. Buchroithner *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 35-39 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

Various experiments were made in the field of geological application, thanks to the data of space Synthetic Aperture Radar (SAR) of Seasat, SIR-A and SIR-B. The acquired know-how will be transferred to the future space radar missions of SIR-C and ERS-1. The potential of space SAR image data lies in the general, economical and technical geology: lithology and tectonic mapping, oil, gas, ore, minerals exploration, as well as the determination of constructive location for buildings. So called secondary image products which include geocoded images, stereographs, multi-parameter color combinations, and perspective views will support in the future the application possiblities of SAR data. ESA

N91-12997# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Hauptabt. Angewandte Datentechnik.

GOECODED PRODUCTS OF FUTURE RADAR SENSORS [GEOCODIERTE PRODUKTE ZUKUENFTIGER RADARSENSOREN]

Gunter Schreier *In its* Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 41-44 In GERMAN (For primary document see N91-12992 04-43)

Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

Geocoded image data of remote sensing satellites allows one to coordinate directly the digital information with a determined position on the Earth surface, thus forming a key element for the integration of the space supported environment data with digital enquiries from other sources (for example, in the framework of a geographical information system). Such a type of geometrical improved data is produced as user data for the future remote sensing systems, in particular for the Synthetic Aperture Radar (SAR) system. Data banks and topographic maps were created for the operational handling of these data. ESA

N91-12998# European Space Agency. ESRIN, Frascati (Italy). Earthnet.

MOS-1 Status Report [MOS-1 STATUSREPORT] **c18**

Juerg Lichtenegger *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 45-46 In GERMAN (For primary document see N91-12992 04-43)

Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

The Japanese Marine Observation Satellite (MOS-1) has been in a Sun synchronous orbit since 1987. Its repetition cycle amounts to seventeen days. Its payload is described. Combined products (e.g., data from more than one sensor) are still to be developed. Only single products are currently offered. ESA

N91-12999# Freie Univ., Berlin (Germany, F.R.). Inst. fuer Meteorologie.

VEGETATIVE INDEX FOR EUROPE [VEGETATIONSINDEX FUER EUROPA]

Matthias Eckardt and Wolfgang Tonn *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 47-51 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)

Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

On the basis of the Global Area Coverage (GAC) data, global vegetative index maps were produced. The vegetative index is operational for Central Europe and the Iberian peninsula. The influence of the atmosphere is not to be neglected, as it appears from model calculations. The exact knowledge of the bidirectional reflection function on the ground is important. It is not possible to distinguish clearly various vegetative forms, using the vegetative index only. ESA

N91-13000# Bundeswehr fuer Wasserschall- und Geophysik, Kiel (Germany, F.R.).

WATER SURFACE TEMPERATURES FROM THERMAL SATELLITE IMAGES [WASSEROBERFLAECHENTEMPERATUREN AUS THERMISCHEN SATELLITENBILDERN] **c48**

Peter L. Lobemeier *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 53-57 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)

Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

Weather satellites of TIROS-N type give thermal images of the sea surface. The Planck radiation law determines the temperature for a black body from the radiation intensity in a wavelength band. Water behavior is almost similar to a black body. Measurements of the aerosol content of air were conducted with a lidar system. Simultaneously, the temperature and the humidity profiles of the atmosphere were determined using radio sondes. The radiation temperature values were compared to in situ measurements. Various observations showed that it was necessary to know the meteorological conditions in the region examined to explain correctly thermal satellite images. ESA

N91-13001# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Angewandte Datentechnik.

THE DIFFERENTIATION OF SEA ICE THICKNESS AND SURFACE SHAPE, USING NOAA-AVHRR AND SAR DATA [UEBER DIE DIFFERENZIERUNG VON MEEREISDICKE UND -OBERFLAECHENGESTALT MIT HILFE VON NOAA-AVHRR UND SAR-DATEN]

Christine Koenig *In its* Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 59-64 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)

Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

An automatic classification process for identifying small ice configurations and the exact geographical localization of ice fields are presented. The results obtained showed that NOAA Advanced Very High Resolution Radiometer (AVHRR) data and SAR Synthetic Aperture Radar (SAR) data are complementary. When NOAA recordings gave information on ice thickness and humidity content of the ice surface, ice structure could be taken out, using radar. It is still to be investigated how a superposition of both types of sensor could form an additional information source. ESA

N91-13002# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Hauptabt. Angewandte Datentechnik.

INVESTIGATIONS INTO THE DYNAMICS OF SEA ICE IN THE EAST GREENLAND SEA REGION, IN MAY 1988, USING NOAA-AVHRR DATA [UNTERSUCHUNGEN ZUR DYNAMIK DES MEEREISES IM BEREICH DER OSTGROENLANDSEE IM MAI 1988 UNTER VERWENDUNG VON NOAA-AVHRR-DATEN]

Stefan W. Dech *In its* Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 65-71 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)

Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

Data records of the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA-9 and NOAA-10 satellites were extracted to analyze the causes of sea ice motion in the east Greenland sea. The sea ice spreading influenced notably the heat exhange between the ocean and the atmosphere and represented an important element for the controlling means of the global climate. Sea ice motion data was extracted through a statistical cross correlation process, and filed under the form of ice flows displacement vectors. The satellite data was calibrated. Out of the vector fields obtained, the drift relationships and the velocities of the drift ice zone were determined. The NOAA satellite data showed they were perfectly adapted to sea ice monitoring. ESA

N91-13003# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
THE USE OF REMOTE SENSING DATA FOR A STATISTICAL GROUND APPLICATION INFORMATION SYSTEM (STABIS, GERMAN ACRONYM) [DIE VERWENDUNG VON FERNERKUNDUNGSTADEN FUER EIN STATISTISCHES BODENNUTZUNGSINFORMATIONSSYSTEM (STABIS)]
Klaus Niemz *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 73-78 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

Satellite photos are to be more and more used, because of their essential advantages, such as high temporary resolution, high geometrical resolution, and high spectral resolution. Current and low cost data were collected for very different users. They were actualized and processed with modern computer techniques. They were, from the beginning, in a digital form and directly accessible to the computer. Despite its advantages, the level of acceptance of such information by the users is still low. It is necessary to analyze the user requirements and to match the satellite data contents, its mathematical statistical processing, and its interpretation to the result of this analysis. ESA

N91-13004# Trier Univ., Trier-Tarforst (Germany, F.R.). Angewandte Physische Geographie, Fach Fernerkundung.
CLASSIFICATION OF THEMATIC MAPPING (TM) DATA AS A REMOTE SENSING CONTRIBUTION FOR A HYDROLOGICAL DISCHARGE MODEL [KLASSIFIKATION VON TM-DATAN ALS BEITRAG DER FERNERKUNDUNG FUER EIN HYDROLOGISCHES ABFLUSSMODELL]
Stefan Kleeschulte *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 79-84 In GERMAN (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

A TR-20 model was developed in the U.S. by the Soil Conservative Service (SCS). The mathematical basis of the model was the unit hydrograph theory. Through the use of physiographical properties (for example, relief) and measurable hydrological ground parameters (such as water permeability) it was attempted to make the model as independent of calibration as possible. The results of the discharge simulation, as illustrated, show the course of high waters and, in comparison, the calculated high waters. The two most important characteristics of high waters, the peak discharge and the peak discharge inlet time, as measured and calculated, are in good agreement. ESA

N91-13005# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Fernerkundungsanwendungen.
INVESTIGATIONS OF SATELLITE IMAGE AND REFERENCE DATA FOR EXPLORATION [EXPLORATIONSBEZOGENE UNTERSUCHUNGEN AN SATELLITENBILD- UND REFERENZDATEN]
Dieter Schlichter *In its* Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 85-90 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

A reproducible and rapid remote sensing method for mapping ore structures in crystalline Archaean rocks is presented. Interesting results were obtained when the single digit planes were median filtered. The median filter did not generate any new gray scale value, but placed, as a central pixel, the preponderant value. ESA

N91-13006# Naval Oceanographic Office, Bay Saint Louis, MS.
AIRCRAFT MEASUREMENTS IN THE NORTHEAST PACIFIC, SUMMER 1989
J. D. Boyd Jul. 1990 225 p
(AD-A225857; NOARL-TN-40) Avail: NTIS HC/MF A10 CSCL 08/3

Between 25 June t0 19 July 1989, an experiment deploying over 800 deep and shallow airborne expendable bathythermographs (ABXTs) was conducted in the subarctic frontal zone of the Northeast Pacific, between approximately 32 deg to 43 deg N, 138 deg to 151 deg W. The operation was part of the validation phase of the Naval Oceanographic and Atmospheric Research Laboratory's (NOARL's) Northeast Pacific Modeling Project (NEPAC). This document describes the experimental plan and the data acquisition processing techniques used for the NEPAC experiment and presents the resulting data in graphical form. GRA

N91-13007# Naval Oceanographic Office, Bay Saint Louis, MS.
COMPARISON OF THEMATIC MAPPER AND NOARL SCANNER MULTISPECTRAL BATHYMETRY ESTIMATES Final Report
Maria T. Kalcic, Charles L. Walker, and Harold V. Miller Jun. 1990 19 p
(AD-A226273; NOARL-4) Avail: NTIS HC/MF A03 CSCL 08/3

The Mapping, Charting, and Geodesy Division of the NOARL investigates methods to exploit the application of multispectral data to coastal water mapping and charting requirements. The Coastal Image Understanding project high-resolution, multispectral, aircraft data has been examined and compared with lower-resolution satellite data from the thematic mapper on board NASA's LANDSAT. The high-resolution, nine-band scanner used was developed for the Airborne Bathymetric Survey System. The NOARL scanner has increased spectral sensitivity in the blue and green portions of the electromagnetic spectrum to take advantage of the water-penetrating bands, the multiband generalized ratio model is used to compare bathymetry estimates from the scanner and the thematic mapper, which has five bands. Results show improvement from increased resolution in the 3-m to 6-m area. Root-mean-square (RMS) errors of 0.323 m at the 3-m depth range for the NOARL Scanner are close to the International Hydrographic Office standard of 0.3 m; however, errors at other depth ranges exceed this standard by even greater values. RMS errors of 0.544 m for the NOARL scanner contrast with 0.907 m for the thematic mapper at the 4-m range. Beyond 6-m depth, results do not differ significantly between the two scanners. GRA

N91-13008# Arcon Corp., Waltham, MA.
EFFECTIVE DIELECTRIC CONSTANTS OF FOLIAGE MEDIA Interim Report, Feb. 1989 - Jan. 1990
Douglas Tomasanis Jul. 1990 119 p
(Contract F19628-89-C-0186; AF Proj. 4600)
(AD-A226296; RADC-TR-90-157) Avail: NTIS HC/MF A06 CSCL 20/3

The output from a model that calculates the effects of multiple scattering processes that influence the scattering and absorption of electromagnetic radiation by dense foliage is presented. Results are presented as effective dielectric constants which can be used to represent the forest environment as a homogeneous dielectric slab in electromagnetic scattering models. An objective of this report is to present a formalism that allows the reader to incorporate the results into a simulation program. Several models of multiple scattering processes in the foliage media are considered for determining the effective parameters. A brief discussion of the Average T-Matrix Approximation (ATA) and the Coherent Potential Approximation (CPA) are presented. GRA

N91-13009*# Connecticut Univ., Storrs.
A THEORY OF FOREST DYNAMICS: SPATIALLY EXPLICIT MODELS AND ISSUES OF SCALE
S. Pacala 1990 3 p

(Contract DE-FG02-90ER-60933)
(NASA-CR-187645; NAS 1.26:187645; DE91-000825;
DOE/ER-60933/1) Avail: NTIS HC/MF A01 CSCL 02F

Good progress has been made in the first year of DOE grant (number sign) FG02-90ER60933. The purpose of the project is to develop and investigate models of forest dynamics that apply across a range of spatial scales. The grant is one third of a three-part project. The second third was funded by the NSF this year and is intended to provide the empirical data necessary to calibrate and test small-scale (less than or equal to 1000 ha) models. The final third was also funded this year (NASA), and will provide data to calibrate and test the large-scale features of the models. DOE

N91-13010# National Environmental Satellite Service, Washington, DC.
DATA EXTRACTION AND CALIBRATION OF TIROS-N/NOAA RADIOMETERS
Walter G. Planet, ed., Levin Lauritson, Gary J. Nelson, and Frank W. Porto Oct. 1988 153 p Revised
(NOAA-TM-NESS-107-Rev-1) Avail: NTIS HC/MF A08 CSCL 05B

The TIROS N/NOAA series is the third generation of environmental satellites providing real-time data to direct readout users. Information is presented that enables users to extract from the telemetry streams data that are unique to a given sensor, to calibrate these data, and to develop an understanding of the accuracy and precision that can be expected of the calibrated data. GRA

N91-13322*# Mercer Univ., Macon, GA. Dept. of Electrical and Computer Engineering.
RADIOMETER SYSTEM REQUIREMENTS FOR MICROWAVE REMOTE SENSING FROM SATELLITES
Jeng-Nan Juang *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 66-68 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 14B

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N91-13011 Reading Univ. (England).
THE DESIGN OF FIBRE-REINFORCED COMPOSITE BLADES FOR PASSIVE AND ACTIVE WIND TURBINE ROTOR AERODYNAMIC CONTROL Ph.D. Thesis
Nicos M. Karaolis 1989 269 p
Avail: Univ. Microfilms Order No. BRDX90037

An alternative method of varying the pitch of wind turbine rotor blades is examined, which relies on the use of fiber reinforced composite materials to design the blades so as to develop elastic coupling between an applied load of a generally twisting and non-twisting nature. With such an approach, twist can be obtained either by using one of the forces experienced by the blade during operation to alter passively the blade pitch, or by internal pressurization to control actively the blade pitch by varying the pressure. The passive control option is considered in detail. First the relevant composite construction geometries that produce the desired coupling effect are identified and then a theoretical model is developed. This is also used to explore the variation in coupling and stiffness properties with the fiber orientation. Various materials are considered including glass, aramid, and carbon fiber epoxy composites. Subsequently, the structural model is confirmed experimentally by a series of tests on composite, foam-cored beams specially designed and manufactured for this purpose. It is then combined with existing aerodynamic theories in order to model the performance of horizontal and vertical axis rotors employing such blades. The effect of passively induced twist on the aerodynamic performance is examined both theoretically and experimentally. Additionally, a simplified dynamic model is developed to obtain a general idea on how built-in elastic coupling may affect the dynamic stability of a horizontal axis rotor system. The active control option is considered in general as an alternative mechanism of inducing twist. The relevant theory is derived and illustrated with examples, and the realistic practicability of this concept is discussed. To validate the theory, a composite cylindrical shell has been designed, manufactured and tested under pressure. Dissert. Abstr.

N91-13012# Glasstech Solar, Inc., Golden, CO.
AMORPHOUS SILICON SOLAR CELLS PREPARED AT HIGH DEPOSITION RATES Annual Report, 1 Jul. 1989 - 30 Jun. 1990
Dashen S. Shen, Pawan K. Bhat, Hood Chatham, Cheryl Matovich, and Amy Benson Aug. 1990 24 p Prepared for Midwest Research Inst., Golden, CO
(Contracts DE-AC02-83CH-10093; SERI-AB-7-06002-1)
(DE90-000371; SERI/TP-211-3949) Avail: NTIS HC/MF A03

This document describes the progress in the research of amorphous silicon solar cells prepared at high deposition rates. By using high excitation frequency (110 MHz) and optimization of deposition conditions, the electronic properties of i-layers deposited from Si2H6 or SiH4 at approximately 2 nm/s approached the properties of low deposition rate films. B(CH3)3 was used as an alternative p-layer doping gas. The results show that B(CH3)3 is a better doping gas than B2H6, due to its better thermal stability and produces a film with better electro-optical properties. The open-circuit voltage, V(sub oc), of the devices has been improved by using a B(CH3)3 p-layer and a better p/i interface layer. The short circuit current density, J(sub sc), was improved by using an ITO/Ag back reflector. The key for fabricating high-deposition-rate SiH4 devices was found to be the p/i interface. As a result, high-deposition-rate cells deposited from both Si2H6 and SiH4 source gases reached 10 percent efficiencies. A 1 sq cm cell deposited at 2 nm/s from Si2H6 reached 10.1 percent initial efficiency as measured by the Solar Energy Research Institute. DOE

N91-13013# Technology Propects, Inc., Falls Church, VA.
GEOTHERMAL DEVELOPMENT OPPORTUNITIES IN DEVELOPING COUNTRIES
Deepak C. Kenkeremath, ed. 16 Nov. 1989 90 p Seminar held in Washington, DC, 16 Nov. 1989
(Contract DE-FG07-89ID-12850)
(DE90-017613; DOE/ID-12850/3; CONF-8911226) Avail: NTIS HC/MF A05

This report is the proceedings of the Seminar on geothermal development opportunities in developing countries, sponsored by the Geothermal Division of the U.S. Department of Energy and presented by the National Geothermal Association. The overall objectives of the seminar are: (1) Provide sufficient information to the attendees to encourage their interest in undertaking more geothermal projects within selected developing countries, and (2) Demonstrate the technological leadership of U.S. technology and the depth of U.S. industry experience and capabilities to best perform on these projects. DOE

N91-13014# Sandia National Labs., Albuquerque, NM.
CUSTOMIZED AIRFOILS AND THEIR IMPACT ON VAWT COST OF ENERGY
Dale E. Berg 1990 9 p Presented at the Windpower '90, Washington, DC, 25-28 Sep. 1990
(Contract DE-AC04-76DP-00789)
(DE91-000408; SAND-90-1148C; CONF-9009107-1) Avail: NTIS HC/MF A02

Sandia National Laboratories has developed a family of airfoils specifically designed for use in the equatorial portion of a

Vertical-Axis Wind Turbine (VAWT) blade. An airfoil of that family has been incorporated into the rotor blades of the DOE/Sandia 34-m diameter VAWT Test Bed. The airfoil and rotor design process is reviewed. Comparisons with data recently acquired from flow visualization tests and from the DOE/Sandia 34-m diameter VAWT Test Bed illustrate the success that was achieved in the design. The economic optimization model used in the design is described and used to evaluate the effect of modifications to the current Test Bed blade. DOE

N91-13015# Solarex Corp., Rockville, MD.
HIGH-EFFICIENCY SILICON SOLAR CELLS FOR USE WITH A PRISMATIC COVER AT 160 SUNS
J. R. Silver and B. Patel Aug. 1990 46 p Prepared for Sandia National Labs., Albuquerque, NM
(Contract DE-AC04-76DP-00789)
(DE91-000468; SAND-90-7030) Avail: NTIS HC/MF A03

For this program, Solarex developed a process sequence that could be used in a manufacturing environment to produce high-efficiency silicon concentrator cells. The cells had large gridlines to minimize series resistance losses and a prismatic cover to minimize shadowing. The front surface of the cell was textured to improve absorption of light and passivated to reduce front-surface recombination. Two separate diffusions steps were used: a deep emitter with a light surface concentration and a heavy diffusion to reduce recombination under the front contacts. Cell efficiencies as high as 22.25 percent were demonstrated at 75 suns and over 21.5 percent at 150 suns air mass 1.5 illumination. DOE

N91-13016# Sandia National Labs., Albuquerque, NM. Wind Energy Research Div.
FATIGUE ANALYSIS OF WECS (WIND ENERGY CONVERSION SYSTEM) COMPONENTS USING A RAINFLOW COUNTING ALGORITHM
Herbert J. Sutherland and Larry L. Schluter 1990 8 p Presented at the Windpower 1990, Washington, DC, 25-28 Sep. 1990
(Contract DE-AC04-76DP-00789)
(DE91-000774; SAND-90-1149C; CONF-9009107-2) Avail: NTIS HC/MF A02

A rainflow counting algorithm has been incorporated into the LIFE2 fatigue/fracture analysis code for wind turbines. The count algorithm, with its associated pre- and post-count algorithms, permits the code to incorporate time-series data into its analysis scheme. After a description of the algorithms used here, their use is illustrated by the examination of stress-time histories from the Sandia 34-m Test Bed vertical axis wind turbine. The results of the rainflow analysis are compared and contrasted to previously reported predictions for the service lifetime of the fatigue critical component for this turbine. DOE

N91-13017# Sandia National Labs., Albuquerque, NM.
PERFORMANCE OF AMORPHOUS SILICON PHOTOVOLTAIC SYSTEMS, 1985-1989
Apr. 1990 21 p
(Contract DE-AC04-76DP-00789)
(DE91-000480; SAND-90-0612) Avail: NTIS HC/MF A03

This report discusses the performance of commercial amorphous silicon modules used in photovoltaic power systems from 1985 through 1989. Topics discussed include initial degradation, reliability, durability, and effects of temperature and solar irradiance on peak power and energy production. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N91-13018# National Oceanic and Atmospheric Administration, Boulder, CO. Climate Monitoring and Diagnostics Lab.
ECC OZONESONDE OBSERVATIONS AT MIRNY, ANTARCTICA, DURING 1989
W. D. Komhyr, J. A. Lathrop, V. N. Arbuzova, V. U. Khattatov, and V. I. Pilipenko Jun. 1990 90 p Prepared in cooperation with Central Aerological Observatory, Dolgoprudnyi (USSR)
(PB90-252024; NOAA-DR-ERL-CMDL-4) Avail: NTIS HC/MF A05 CSCL 13B

The ozone decrease indicated in Antarctica in recent years by Dobson spectrophotometer and satellite observation is studied using 24 balloon electrochemical concentration cell (ECC) ozonesonde soundings made at Mirny, Antarctica, in 1989. This report presents ozone, air temperature, potential temperature, and wind data as a function of pressure and geopotential altitude for manditory and significant ozone levels together with vertical profile plots of ozone partial pressure, air temperature, and wind speed and direction. GRA

N91-13019# Environmental Protection Agency, Washington, DC. Office of Policy, Planning and Evaluation.
REPORT OF THE EXPERT GROUP ON EMISSIONS SCENARIOS OF THE RESPONSE STRATEGIES WORKING GROUP OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
Apr. 1990 56 p
(PB90-253170) Avail: NTIS HC/MF A04 CSCL 13B

Emission Scenarios: Report of the Expert Group on Emission Scenarios, includes the United States and the Netherlands, from the Response Strategies Working Group of the Intergovernmental Panel on Climate Change, April 1990. Five scenarios are presented in which greenhouse gas emissions could change over the next century: High Emissions; Low Emissions; Control Policies; and Accelerated Policies (two scenarios). The scenarios also illustrate changes that might stabilize emissions and allow growth and improvement in the standard of living. Considers goals of 20 percent reduction in CO2 emissions by the early part of the next century (Toronto Conference: The Changing Atmosphere - 1988). GRA

N91-13020# Environmental Protection Agency, Washington, DC. Office of Policy, Planning and Evaluation.
REPORT OF THE EXPERT GROUP ON EMISSIONS SCENARIOS OF THE RESPONSE STRATEGIES WORKING GROUP OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE: APPENDIX
Apr. 1990 230 p
(PB90-253188) Avail: NTIS HC/MF A11 CSCL 13B

Back-up data are presented to the five scenarios of potential climate change in greenhouse gas emissions over the next century and changes to stabilize emissions, as presented in 'Emission Scenarios: Report to the Expert Group on Emission Scenarios' from the Response Strategies Working Group of the Intergovernmental Panel on Climate Change, April 1990. GRA

N91-13021 Georgia Inst. of Tech., Atlanta.
A THREE-DIMENSIONAL GLOBAL DYNAMICAL AND CHEMICAL MODEL OF METHANE Ph.D. Thesis
XueXi Tie 1990 203 p
Avail: Univ. Microfilms Order No. DA9023831

A three-dimensional global chemical and dynamical methane model was generated which includes horizontal and vertical advection, diffusion, chemical reactions, and surface release terms. The input winds and sinks vary with the seasons and a lone seasonal variation in the source is introduced to simulate rice paddy release. The calculated results are compared with measured methane horizontal distributions, vertical profiles, latitudinal distributions, and zonal cross sections. The calculated surface horizontal distributions are consistent with methane measurement at 23 stations from about 76 degrees N to the south pole. The calculated surface methane shows a maximum around Asia in the rice harvest season. However, there are essentially no measured methane values in this area to compare with these calculations. In the lower troposphere of the Northern Hemisphere, methane exhibits a seasonal cycle which is mainly driven by the seasonal cycles of the die releases, the chemical sinks, and transport. There are two rice production seasons which produced, according to the calculations, an increase in the methane transport to the

northeast of the rice productions areas in eastern Asia. In the lower troposphere of the Southern Hemisphere, the methane seasonal cycle exhibits a maximum in September and a maximum in March which are mainly driven by the seasonal cycles of the chemical sinks. However, in the upper troposphere, the methane cycle is mainly influenced by transport. In the stratosphere, methane flows readily between the Northern Hemisphere and the Southern Hemisphere. The calculated methane has a maximum around 20 degrees N in July and 20 degrees S in January. Methane measured by satellite (Nimbus 7) shows similar spatial and temporal features. Dissert. Abstr.

N91-13022# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STUDY OF RADON CONCENTRATION IN ANTARCTICA: INSTRUMENTATION AND ANALYSIS M.S. Thesis [ESTUDO DAS CONCENTRACOES DE RADONIO NA ANTARCTICA: INSTRUMENTACAO E ANALISE]
Heitor Evangelista daSilva Apr. 1990 286 p In PORTUGUESE; ENGLISH summary
(INPE-5070-TDL/409) Avail: NTIS HC/MF A13

Continuous measurements of the natural radioactive gas Rn-222 are made at the Brazilian Antarctic station 'Comandante Ferraz' (62 deg S, 58 deg W) to study the continental influence of air masses over the Antarctic peninsula. The technique employed in the measurements is based on the process of electrostatic collection of the ionized Polonium isotopes (the Radon decay products). The efficiency of collection is on the order of 50 to 75 percent for an applied electric potential of 17 kV. The collection chamber has a hemispheric shape in order to optimize the collection yield. The observed radioactivity at the Ferraz station for the period March to November 1986 to 1987 exhibited different behaviors. The year 1986 showed an average radioactivity of 2.6 + or - 1.8 x 10(exp -2) Bq/cu m, while in 1987 a 50 percent decrease in the concentration was observed with a value of 1.44 + or - 0.8 x 10(exp -2) Bq/cu m. Associated variations of wind velocity and continental aerosol loads were also observed. Periodicities in the radon time series displayed more intense peaks at 25 to 30 day periods. No seasonal trend was observed. Transient increases of radon correlated with short deicing periods. The average flux of Rn were calculated from a sampling network consisting of 20 points spread over the exposed regoliths and outcrops of the King George island, with values of 250 atoms/sq m/sec for the Rn-220 and 7500 atmos/sq m/sec for the Rn-222 isotope.
Author

N91-13023# Naval Ocean Systems Center, San Diego, CA. Marine Environmental Support Office.
PROCEEDINGS OF THE ENVIRONMENTAL RESEARCH AND DEVELOPMENT (R/D) TECHNICAL WORKSHOP Final Report
Jun. 1990 314 p Workshop held in San Diego, CA, 7-9 Nov. 1989 Sponsored by Naval Facilities Engineering Command
(AD-A225806; NOSC/TD-1792) Avail: NTIS HC/MF A14 CSCL 24/3

Environmental protection is becoming one of the top priorities for the Department of Defense and the Navy. How do we achieve compliance with the staggering environmental requirements. How do we maintain mission readiness and meet operational requirements while simultaneously protecting the environment. How do we pay for environmental protection technology. How can we implement available technology and develop needed technology in order to improve our environmental protection record without exceeding budget restraints. These were some of the issues addressed by the Environmental Research and Development (R and D) Technical Workshop. The workshop addressed the technical issues of the Navy's hazardous waste minimization (HAZMIN), installation restoration (IR) and pollution abatement (PA) programs. GRA

N91-13024# Du Pont de Nemours (E. I.) and Co., Aiken, SC.
WETLANDS MAPPING WITH SPOT MULTISPECTRAL SCANNER DATA
H. E. Mackey, Jr. and J. R. Jensen (South Carolina Univ., Columbia.) 1989 11 p Presented at the 9th Annual Convention of the American Society for Photogrammetry and Sensing/American Congress on Surveying and Mapping Auto-Carto, Baltimore, MD, 2-7 Apr. 1989 Submitted for publication
(Contract DE-AC09-76SR-00001)
(DE91-000780; DP-MS-88-169; CONF-8904117-2) Avail: NTIS HC/MF A03

Government facilities such as the U.S. Department of Energy's Savannah River Plant (SRP) near Aiken, South Carolina, often use remote sensing data to assist in environmental management. Airborne multispectral scanner (MSS) data have been acquired at SRP since 1981. Various types of remote sensing data have been used to map and characterize wetlands. Regional LANDSAT MSS and TM satellite data have been used for wetlands mapping by various government agencies and private organizations. Furthermore, SPOT MSS data are becoming available and provide opportunities for increased spacial resolution and temporal coverage for wetlands mapping. This paper summarizes the initial results from using five dates of SPOT MSS data from April through October, 1987, as a means to monitor seasonal wetland changes in freshwater wetlands of the SRP. DOE

N91-13025# Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
CONCLUSIONS AND RECOMMENDATIONS OF THE JUNE, 1990 BNL WORKSHOP
Bernard Manowitz Aug. 1990 15 p Presented at the Workshop on Global Climate Feedbacks, Upton, NY, 4-6 Jun. 1990
(Contract DE-AC02-76CH-00016)
(DE91-001112; BNL-45190; CONF-9006134-1) Avail: NTIS HC/MF A03

The issue of global change initiated by increases in the concentrations of CO2 and other greenhouse gases is a scientific issue with major policy implications. The best means to examine the response of the Earth's climate to prospective perturbations in radiative forcing caused by such changes, and to other industrial activities, is modeling, specifically by means of general circulation models (GCMs) of the Earth's atmosphere and of the coupled atmosphere-ocean system. The purpose of this workshop was to identify the feedbacks inherent in the Earth's climate that actually or potentially govern the system's response to perturbations, to identify gaps in knowledge that preclude the accurate representation of these feedbacks in models, and to identify research required to represent these feedbacks accurately in models. DOE

N91-13336*# University of Western Carolina, Cullowhee, NC.
ANALYSIS OF PRESSURE-BROADENED OZONE SPECTRA IN THE 3 MICRON REGION
Eleanor S. Prochaska *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 96-99 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 13B

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N91-13026 Arizona Univ., Tucson.
MODELS OF PLATE KINEMATICS ALONG THE WESTERN MARGIN OF THE AMERICAS: CRETACEOUS TO PRESENT Ph.D. Thesis
Gregory Lawrence Cole 1990 550 p
Avail: Univ. Microfilms Order No. DA9025068

A realistic assessment of the uncertainties associated with plate reconstructions is provided by creating empirical probability density functions (PFD's) for rotations between plate pairs based

upon uncertainties in the positions of observed fracture zone and magnetic anomaly crossings. Confidence limits within PDF's were assigned and it was found that worst-case uncertainty regions for global reconstruction poles can be twice as large as 95 percent confidence regions. The technique was illustrated with the anomaly six rotation between the Pacific and North American plates and it was demonstrated that realistic uncertainties for summations of rotations are apt to be significantly smaller than those previously predicted by earlier techniques. Revised apparent polar wander paths were developed for the North American and Pacific plates. Motions of the Pacific plate were determined within the hotspot reference frame for the past 80 Ma and the model was extended back to 145 Ma. By applying realistic limits on the expected error in global plate reconstructions, it was determined that either the South Atlantic hotspot track is improperly defined, or that there has been more than 1,000 kilometers of relative motion between the Pacific and South Atlantic hotspots since 80 Ma. The model of plate interactions for the western Americas indicates subduction perpendicular to the margins from 78 Ma to 33 Ma. Northward transpression and transport of allochthonous terranes is limited to regions north of the evolving Pacific-Izanagi (Kula) ridge. A series of reconstructions is presented which allows quantification of subduction and lateral transport along the margins. The generation of possible oceanic plateaus by known hotspots in the Pacific region shows little evidence to indicate that their subduction had an impact on the magmatic history of North America.

Dissert. Abstr.

N91-13027 Cincinnati Univ., OH.

ON THE ROLE OF ATMOSPHERIC GRAVITY WAVES IN MESOSPHERIC DYNAMICS Ph.D. Thesis

Usama Butros Makhlouf 1989 100 p

Avail: Univ. Microfilms Order No. DA9019853

The effects of downward gravity wave reflection from atmospheric structure and horizontal winds, the geometry of the wave source and observation region, and the relative importance of the horizontal and vertical transport is presented for several different gravity wave models. A quantitative study is also made on the relative importance of the purely gravitationally induced compression (GIC) due to fluid particle altitude change and the actual wave compression which can occur at a fixed altitude in a gravity wave. It was found that: (1) for large scale gravity waves, the downward reflection from atmospheric structure is sufficiently large as to warrant the use of gravity wave models which propagate primarily along the horizontal directions and are stationary along the vertical direction; (2) for small and medium scale gravity waves the stationary model is required only for high altitude sources; (3) the horizontal winds have a profound effect on the downward reflection; (4) in the presence of waves the vertical density transport of the minor species which produce the airglow predominate over the horizontal and vertical velocity transport; (5) the results for density, pressure, and temperature variations show that the GIC effect predominates (less than 95 percent) for v/c less than 20 percent where v is the horizontal phase velocity, and the relative importance depends strongly on frequency for wave periods less than 10 min., but becomes totally independent of the frequency for periods greater than 20 min.; and (6) the temperature measurements can be quickly converted to height variations wherever the GIC effect predominates. In addition, the total kinetic energy density can be simply expressed in terms of height variation and, wherever the GIC predominate, can be very easily obtained from temperature measurements. Dissert. Abstr.

N91-13028# Cologne Univ. (Germany, F.R.). Inst. fuer Geophysik und Meteorologie.

SURFACE ALBEDO AND GLOBAL RADIATION OVER EAST ASIA FROM DATA OF THE GEOSTATIONARY SATELLITE GMS

Xian-Jin Fang 1990 106 p

(Mitt-72; ISSN-0069-5882; ETN-90-97896) Avail: NTIS HC/MF A06

A method to determine the surface albedo and the global radiation over east Asia from the Japanese Geostationary Meteorological Satellite (GMS) B1-format satellite data was improved. Radiative transfer modeling was used, and to improve the accuracy of the derived surface albedo the ratio of the reflected to the total extincted radiation is introduced. Altitude corrections were made based on radiation data from the Tibetan plateau and spectral and anisotropic correction were considered in the model. Details of the data distributions are given. Global radiation distributions illustrate that the topographic effect of the Tibetan plateau are nonnegligible. Relative errors are given for comparing model results with ground observed data. ESA

N91-13029# BBN Systems and Technologies Corp., Canoga Park, CA.

SEISMIC RESPONSE TO SONIC BOOM-COUPLED RAYLEIGH WAVES Final Report, 6 Nov. 1989 - 6 May 1990

Mark R. Legg and Jerold M. Haber 28 Jun. 1990 261 p

(Contract F33615-86-C-0530)

(AD-A225104; BBN-7316; HSD-TR-90-25) Avail: NTIS HC/MF A12 CSCL 08/11

Whenever sonic booms strike the ground a certain amount of energy is transferred to the ground which propagates as seismic waves. Under most conditions, the energy transfer is very inefficient, and the seismic wave energy is dissipated over a relatively short distance. If, however, a supersonic aircraft flew in a manner so that the sonic boom carpet velocity matched the propagation velocity of seismic surface waves (Rayleigh waves), the magnitude of the seismic waves would be amplified. For special soil (ground) characteristics, the energy transfer into the ground becomes more efficient. The seismic energy can propagate with little dissipation, allowing the magnitude of the ground vibrations to build up to damaging levels. If the vibration characteristics of the ground match those of a structure, the potential for structural damage may be significant. Three types of conditions are necessary for sonic boom-coupled Rayleigh waves to pose a threat. The overflown geologic (soil) profile must be characterized by a low velocity layer over a higher velocity layer. An aircraft must fly a steady maneuver for which the sonic boom carpet speed varies by no more than approximately + or - 10 percent over a distance of several wave lengths. The structures in the region must have natural frequencies matching those of the Rayleigh waves and the amplitude and duration of the waves must be great enough to cause damage. Numerous near-surface geologic conditions and soil profiles of the appropriate character exist near supersonic operating areas. This study presents a method to evaluate and classify these conditions based on existing geologic and soil survey maps.

GRA

N91-13030# Los Alamos National Lab., NM.

MODELING OF THE QUASI-STEADY MAGNETOTAIL

Joachim Birn and Karl Schindler (Ruhr Univ., Bochum, Germany, F.R.) 1989 28 p Presented at the Workshop on Magnetosphere-Ionosphere Plasma Models, Huntsville, AL, 11-13 Oct. 1989 Submitted for publication

(Contract W-7405-eng-36)

(DE91-000444; LA-UR-90-2968; CONF-8910462-1) Avail: NTIS HC/MF A03

The three-dimensional theory of the quiet magnetotail is reviewed and updated. The most advanced formulation of the theory allows one to solve the magnetohydrodynamic (MHD) equations including field-aligned flow by reduction to a set of ordinary differential equations and an ordinary integral. These solutions represent lowest order solutions of an asymptotic expansion of the MHD equations for small electric field and weak time dependence. Applications to the magnetotail configuration are presented, which include the following properties in a self-consistent way: Flaring of the tail in y and z, associated with the presence of B(sub y) and B(sub z); variation of plasma sheet and current sheet thickness with x and y, associated with variations of B(sub z); field-aligned currents at the boundary between plasma sheet and lobes with the signature of region 1 currents, i.e., toward the Earth on the dawn side and away on the dusk side, associated with the decrease of the tail flaring with distance from the Earth; net cross-tail magnetic field. Particular steady models with

field-aligned flow demonstrate the important role of the flow in allowing or producing configurations with a transition from a thick closed plasma sheet to a much thinner distant open current sheet and for the possibility of thick plasmoids propagating in near equilibrium through the thin distant current sheet. DOE

N91-13031# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE IMPORTANCE OF FRACTURING IN THE STRUCTURE OF THE PIMENTA-BUENO BASIN (RO) [A IMPORTANCIA DO FRATURAMENTO NO ARCABOUCO DA BACIA DE PIMENTA-BUENO (RO)]
Clayton deSouzaPontes, Paulo Veneziani, Juercio T. deMattos, and J. R. JimenezRueda May 1990 10 p In PORTUGUESE; ENGLISH summary Presented at the 5th Brazilian Symposium on Remote Sensing, Natal, Brazil, 11-15 Oct. 1988
(INPE-5073-PRE/1592) Avail: NTIS HC/MF A02

The Pimenta Bueno Sedimentary Basin is located in the Rondonia State, and is characterized as a graben. Although this tectonic configuration is accepted in the geological community, there is not much knowledge about the stratigraphy, structural patterns, and economic potential of the basin. The objective is to identify old crustal weakness lines which would have acted significantly during the subsidence and sedimentation processes. They could also have been responsible for the paleogeographic, sedimentologic, and tectono/structural controls of this basin. This research was carried out by the use of remote sensing products, in the scale of 1:250,000 (Radar mosaic and LANDSAT-TM images), as well as by the use of digital analysis techniques. According to the first results, the EW-N65W, N40-50W, NS-N10E, and N40-45E fracture trends are the main controlling structural features in the Pimenta Bueno Basin. Author

N91-13032# Naval Postgraduate School, Monterey, CA.
IDENTIFICATION OF THERMOSPHERIC DAYGLOW EMISSIONS FOR THE MUSTANG EXPERIMENT M.S. Thesis
Gary M. Danczyk Dec. 1989 103 p
(AD-A225473) Avail: NTIS HC/MF A06 CSCL 04/1

Thermospheric air glow emissions in the wavelength range of 1800 A to 3400 A, and altitude range of 100 to 330 km were identified. These emissions compose the preliminary data analysis for the MUSTANG rocket experiment. Identification of emissions in the wavelength range of the MUSTANG experiment was accomplished using experimental results to support calculated emission feature intensity. All emission features that will contribute to the experimental spectra, as well as those features that will be distinguishable have been tentatively identified. These results confirm the contention that the instrument wavelength range allows observation of major mid-ultraviolet airglow emission bands. The extended wavelength and altitude range for this experiment allows a unique experiment allows a unique experimental opportunity to observe all major neutral atmospheric constituents in one spectrum. The primary emission band systems that will be observed are the N2 Lyman-Birge-Hopfield bands, the O2 Schumann-Runge bands, the NO Gamma bands and the O 2972A line. Secondary contributions will be observed from the N2 Vegard-Kaplan and 2nd Positive bands, the O2 Herzberg bands, and the NO Epsilon and Delta bands. These combined spectra will insure the MUSTANG experimental goal of measuring N2 and NO densities, and determining EUV and photoelectron fluxes can be met. GRA

N91-13033# Army Missile Command, Redstone Arsenal, AL. Research Directorate.
OCCURRENCE AND DETECTION OF SUPERCOOLED WATER IN THE ATMOSPHERE Final Technical Report, May 1989 - Mar. 1990
Dorathy A. Stewart 27 Jun. 1990 40 p
(AD-A225715; AD-E951519; AMSMI/TR-RD-RE-90-4) Avail: NTIS HC/MF A03 CSCL 04/2

A brief introduction to supercooling is followed by a general discussion of clouds and fog. The next consideration is the freezing of supercooled drops on objects, and the primary concern here is aircraft icing. Climatological information on icing conditions is included for the Federal Republic of Germany. The relative merits of different wavelengths for remote sensing of clouds are examined. Author (GRA)

N91-13034# Aerospace Corp., El Segundo, CA. Lab. Operations.
THE VARIATION OF THE PLASMA SHEET POLYTROPIC INDEX ALONG THE MIDNIGHT MERIDIAN IN A FINITE WIDTH MAGNETOTAIL
H. E. Spence and M. G. Kivelson 15 Aug. 1990 19 p Prepared in cooperation with California Univ., Los Angeles
(Contract F04701-88-C-0089)
(AD-A225948; TR-0089(4940-06)-8; SSD-TR-90-17) Avail: NTIS HC/MF A03 CSCL 04/1

The polytropic index is obtained as a function of distance along the midnight meridian in the terrestrial magnetotail. As our purpose is to establish the effects of the finite width of the magnetotail, we use a simple theoretical model of plasma sheet convection, i.e., two-dimensional field structure and adiabatic inward convection of a uniform distant tail source. Particle orbits are treated independently for portions of the phase space distribution on shells of constant energy. On the midnight meridian, the moments of the distribution are parameterized by tau, the ratio of half the cross-tail potential energy to the characteristic Maxwellian energy of a distant down-tail plasma source. We infer from the model the plasma pressure, P, and the number density, n, along the midnight meridian as a function of tau. P and n define locally an effective polytropic index. Gamma ranges between 5/3 and 1, depending on the value of tau and on geocentric distance. The qualitative differences between the recent empirical determinations of the polytropic index by Baumjohann and Paschmann and Huang et al., may be accounted for in part by this simple model. GRA

N91-13035# Naval Oceanographic Office, Bay Saint Louis, MS.
SEISMIC REFLECTION PROFILES, SOMALI BASIN DATA REPORT: USNS WILKES Technical Report, FY1977-FY1979
William J. Vestal and William P. Searcy, III Dec. 1989 63 p
LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(AD-A226050; NOO-TR-300) Avail: NTIS HC/MF A04 CSCL 08/11

The Somali Basin and contiguous sedimentary basins comprise an inverted L-shaped area of about 1,300,000 square miles in the western Indian Ocean, bounded by the African coasts of Somalia, Kenya, and Tanzania on the west, the Carlsberg Ridge on the north and east, and the northwest coast of the Malagasi Republic (Madagascar) and the Amirante Ridge-trench complex on the south-west. During the period 1977 to 1979, the USNS WILKES collected over 20,000 miles of reflection seismic data in the Somali Basin, along with bathymetry, magnetics, and other data. Photographic reproductions of much of the ten-second seismic analogs are reproduced in this volume. Emphasis has been placed on data in the main part of the basin where survey tracks were concentrated. GRA

N91-13036# Rome Air Development Center, Griffiss AFB, NY.
ANALYTIC RAY TRACING USING ERMAKOV INVARIANTS Report, Dec. 1986 - Dec. 1988
Stanford P. Yukon Nov. 1989 41 p
(AD-A226219; RADC-TR-89-274) Avail: NTIS HC/MF A03 CSCL 04/1

A method for the rapid generation of raypaths and ionograms in model ionospheres is presented. The ionosphere is first cast into the form of a soluble potential well with range dependent parameters. An analytic calculation of raypaths may then be carried out in the paraxial approximation using the theory of Ermakov invariants. The correspondence of rays to full wave coherent states and the possibility of ionospheric convergence zones are discussed. GRA

N91-13037# Utah State Univ., Logan. Center for Atmospheric and Space Sciences.
DURIP APPLICATION OF MULTIPROCESSING TO REAL-TIME ANALYSIS AND CONTROL OF AN IONOSPHERIC RESEARCH RADAR Final Technical Report, 1 Dec. 1988 - 30 Apr. 1990
Frank T. Berkey 29 Jun. 1990 17 p
(Grant AF-AFOSR-0094-89; AF Proj. 3842)
(AD-A226332; CASS-90-7-01; AFOSR-90-0878TR) Avail: NTIS HC/MF A03 CSCL 17/9

The utilization of high-frequency (HF) radio waves to probe the ionosphere was begun more than 50 years ago when the first swept frequency vertical incidence ionospheric sounder (ionosonde) was developed (Villard). A technology evolved, so did the design of ionospheric sounders and several generations of sounders have been developed. As a result, the ionosonde has continued to remain a viable tool for the ionospheric physicist and vast amounts of ionospheric data have been collected. Over the past two decades, with the incorporation of digital technology into ionosondes, more sophisticated ionospheric sounders have been developed, with the capability of measuring the amplitude, phase, angle-of-arrival, polarization and Doppler shift in addition to the time-of-flight (i.e., range) of the returned echo (Wright and Fedor; Reinisch). These systems have also employed digital recording techniques, markedly simplifying the analysis interpretation of ionograms. Details of the NOAA digital ionospheric sounding radar and the Lowell University Digisonde are discussed briefly as the design concepts are representative of state-of-the-art ionospheric sounders. GRA

N91-13038# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS. Mapping, Charting, and Geodesy Div.
A PREDICTIVE GEOMAGNETIC FIELD MODEL FOR EPOCH 1990.5
M. G. McLeod Aug. 1990 39 p
(AD-A226491; NOARL-TN-63) Avail: NTIS HC/MF A03 CSCL 08/4

A predictive model of the geomagnetic field for epoch 1990.5 has been developed. The model is based on the DGRF model for 1980.5 updated to 1990.5 by use of a secular variation model for 1980.0 developed at (NOARL). The NOARL secular variation model is based upon annual means of vector geomagnetic field components from 73 magnetic observatories for years 1976.5 through 1983.5. The predictive model is of degree and order 10. The rms error of the predictive models is estimated to be 200 nT relative to an accurate degree 10 field for epoch 1990.5. Peak errors relative to an accurate model are estimated to be 500 nT for vector field error magnitude and + or - 350, + or - 250, and + or - 500 nT for north, east, and vertical field components errors, respectively. If the DGRF model for 1980.5 were used without updating representing the degree 10 field for 1990.5, estimated errors would be about four times as large. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N91-13039*# New Mexico Inst. of Mining and Technology, Socorro.
AIRCRAFT MEASUREMENTS OF ELECTRIFIED CLOUDS AT KENNEDY SPACE CENTER, PART 3 Final Report
J. J. Jones, W. P. Winn, S. J. Hunyady, C. B. Moore, J. W. Bullock, and P. Fleischhacker (Fleischhacker, P., San Antonio, TX) 21 Aug. 1990 207 p
(Grant NAG8-751)
(NASA-CR-186964; NAS 1.26:186964) Avail: NTIS HC/MF A10 CSCL 04B

Flights made by the Special Purpose Test Vehicle for Atmospheric Research (SPTVAR) airplane during a second deployment to Florida during the summer of 1989 are discussed. The findings based on the data gathered are presented. The progress made during the second year of the project is discussed. The summer 1989 study was carried out with the support and guidance of Col. John Madura, Commander of Detachment 11, 2nd Weather Squadron, USAF, at Patrick Air Force Base (PAFB) and Cape Canaveral Air Force Station. The project goals were to develop and demonstrate techniques for measuring the electric field aloft and locating regions of charge during flight within and near clouds; to characterize the electric conditions that are presently identified as a threat to space launch vehicles; and to study the correlation between the electric field aloft and that at Kennedy Space Center's ground-based electric field mill array for a variety of electrified clouds. Author

N91-13040# Colorado Univ., Boulder.
REPORT FOR GEOGRAPHY AND COLORADO COMMISSION ON HIGHER EDUCATION INTERNSHIP CONVECTIVE WAVE PROJECT
Kurt M. VanSpeybroeck 1990 21 p Prepared in cooperation with National Center for Atmospheric Research, Boulder, CO
Avail: NTIS HC/MF A03

A digitized data set was accumulated of the daily occurrence of cloud streets off the eastern coast of China and North America and a written log of their occurrence in other areas of the Northern Hemisphere is provided. Maps and digitized data files of the frequency of occurrence of cloud streets for the winter months (Dec. to Feb.) on a monthly time scale for each year analyzed and for climatological months averaged over several years are also provided. Author

N91-13041# Beleidscommissie Remote Sensing, Delft (Netherlands).
ESTIMATION OF RAINFALL IN ZAMBIA USING METEOSAT-TIR DATA
J. Huygen (Winand Staring Centre, Wageningen, Netherlands) Mar. 1990 58 p
(BCRS-89-43; ISSN-0924-3062; ETN-90-97690) Copyright
Avail: NTIS HC/MF A04

The results of investigations on the development and validation of algorithms to map rainfall with METEOSAT data in Zambia are presented. The results indicate that it is not possible to apply simple linear relationships to relate the duration of cold cloud top, as obtained with METEOSAT, to dekadic rainfall. The coefficients of these relationships are time dependent. Validation and calibration studies are to be continued. ESA

N91-13042# European Space Agency, Paris (France).
REPORT OF THE CONSULTANCY GROUP ON RAIN RADAR
C. G. Collier, G. Szejwach, J. Testud (Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans, France), and T.-D. Guyenne, ed. Apr. 1990 74 p Original contains color illustrations
(ESA-SP-1119; ISBN-92-9092-048-3; ETN-90-97991) Copyright
Avail: NTIS HC/MF A04; EPD, ESTEC, Noordwijk, Netherlands, HC 30 Dutch guilders

The provision of data on precipitation and the availability of water, the sources and sinks of water and their global distribution, was addressed. Requirements of various users and the means of meeting them using spaceborne instruments were studied. Scientific requirements relating to meteorology, hydrology, climate and ecology are discussed. Active and passive methods including rain radar are described. The following reports are included: programs and projects related to satellite studies; system requirements; addressing the requirements; potential studies. Approaches described include surface reference and dual beam techniques. Combined approaches using satellite data and other data or numerical models are discussed. The general conclusion is that only a combination of techniques will meet user requirements. ESA

N91-13043*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
USER'S GUIDE: NIMBUS-7 EARTH RADIATION BUDGET NARROW-FIELD-OF-VIEW PRODUCTS. SCENE RADIANCE TAPE PRODUCTS, SORTING INTO ANGULAR BINS PRODUCTS, AND MAXIMUM LIKELIHOOD CLOUD ESTIMATION PRODUCTS
H. Lee Kyle, Richard R. Hucek, Brian Groveman, and Richard Frey (Research and Data Systems, Inc., Greenbelt, MD.) Nov. 1990 77 p
(Contract NAS5-29373)
(NASA-RP-1246; Rept-90B00143; NAS 1.61:1246) Avail: NTIS HC/MF A05 CSCL 04B

The archived Earth radiation budget (ERB) products produced from the Nimbus-7 ERB narrow field-of-view scanner are described. The principal products are broadband outgoing longwave radiation (4.5 to 50 microns), reflected solar radiation (0.2 to 4.8 microns), and the net radiation. Daily and monthly averages are presented on a fixed global equal area (500 sq km), grid for the period May 1979 to May 1980. Two independent algorithms are used to estimate the outgoing fluxes from the observed radiances. The algorithms are described and the results compared. The products are divided into three subsets: the Scene Radiance Tapes (SRT) contain the calibrated radiances; the Sorting into Angular Bins (SAB) tape contains the SAB produced shortwave, longwave, and net radiation products; and the Maximum Likelihood Cloud Estimation (MLCE) tapes contain the MLCE products. The tape formats are described in detail. Author

N91-13044# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SUBPROJECT RADSAT Final Report [RELATORIO FINAL DO SUBPROJETO RADSAT]
Nelson Arai Oct. 1988 30 p In PORTUGUESE; ENGLISH summary Sponsored by FINEP/PNAE
(INPE-4808-PRE/1454) Avail: NTIS HC/MF A03

Methods used and main results obtained in the execution of the project Meteorological Satellites Application (PROSAT) subproject for Solar radiation from satellite (RADSAT) are presented. Author

N91-13045# Miami Univ., FL. Div. of Meteorology and Physical Oceanography.
OBSERVATION OF STRATIFORM RAIN WITH 94 GHz AND Ka-BAND RADARS Final Report, 10 Apr. 1987 - 9 Dec. 1989
Roger Lhermitte 23 May 1990 38 p
(Contract F19628-87-C-0106; AF Proj. 2310)
(AD-A225832; GL-TR-90-0004) Avail: NTIS HC/MF A03 CSCL 17/9

The project is concerned with observations of stratiform rain at vertical incidence conducted with a 3-mm wavelength Doppler radar and their analysis and interpretation. The data interpretation is dominated by the need to involve Mie scattering functions which exhibit deep oscillations in the raindrop size range. These considerations lead to a method of separating the contributions of raindrops' terminal velocity and air velocity in Doppler spectra obtained from observation of rain at vertical incidence. Measurements of both weak down-updrafts and raindrop size distribution are thus possible in stratiform rain. The change of radar reflectivity and particle vertical velocity through the layer in which snowflakes are melting on their way to becoming raindrops (melting layer) is also analyzed and interpreted. GRA

N91-13046# Washington Univ., Saint Louis, MO. Center for Air Pollution Impact and Trend Analysis.
VISIBILITY DATA FILTERS FOR EUROPE Report, 19 Sep. 1989 - 14 Apr. 1990
Bret A. Schichtel and Rudolf B. Husar 14 Apr. 1990 44 p
(Contract F19628-87-K-0003)
(AD-A225985; GL-TR-90-0103; SR-2) Avail: NTIS HC/MF A03 CSCL 04/2

The purpose of the report is to present the methodology for filtering the European meteorological visibility data from undesirable and erroneous data. Seven data filters were devised and imposed on the European synoptic visibility data set. The data set consisted of fourteen years of meteorological data (1973 to 1986) for about 1600 station in Europe. The European data set was extracted from the DATSAV global weather database maintained by the U.S. Air Force, ETAC, Scott Air Force Base. The raw meteorological data set consisted of over 1000 magnetic tapes containing about 30 gigabytes of data. The first step in the data processing involved compacting the data set into a binary form, which reduced the data size to a 3 gigabytes. Next, from the daily visibility data, the quarterly cumulative distribution functions for extinction coefficient B(ext) an visibility were computed. Most of the subsequent data filtering was performed using the distribution functions and the Voyager data exploration software. The data cleaning filters fell into three categories: (1) precipitation and humidity filters, (2) filters based on the year to year fluctuation of extinction coefficient, and (3) filters that eliminated entire stations. GRA

N91-13047# Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.
CONTRIBUTIONS TO THE AMERICAN METEOROLOGICAL SOCIETY 16TH CONFERENCE ON SEVERE LOCAL STORMS
M. M. Wolfson 15 Aug. 1990 54 p Conference held in Kananaskis, Alberta, 22-26 Oct. 1990
(Contract F19628-90-C-0002; DTFA-01-L-83-4-10579)
(AD-A226316; ATC-173; DOT/FAA/NR-90/3) Avail: NTIS HC/MF A04 CSCL 04/2

Eight papers contributed by the Lincoln Laboratory Weather Sensing Group to the American Meteorological Society's 16th Conference on Severe Local Storms, to be held October 22 to 26, 1990 in Kananaskis Provincial Park, Alberta, Canada, are compiled in this volume. The FAA sponsored the summer 1989 field test of the Terminal Doppler Weather Radar (TDWR) system in Kansas City, Missouri to detect wind shear aviation hazards at or near the airport. The papers are based on data collected through the summer 1989 field test and on subsequent analyses and product evaluation. The staff members of Group 43, Weather Sensing, have documented their studies of the following topics: a severe microburst; a prototype microburst prediction product; average summer microburst threat prediction at an airport; microburst asymmetry; the effect of radar viewing angle on the performance of the gust front detection algorithm; a comparison of Low-Level Wind Shear Alert System (LLWAS) anemometer-measured winds and Doppler-measured winds; and ASR-9 (Airport Surveillance Radar) adjustment of range-dependent storm reflectivity levels. The final paper is an invited paper for the Conference on microbursts. This paper discusses the precipitation-driven downdraft and the downdraft associated with the vortex, or gust front, at the leading edge of an expanding thunderstorm outflow as two primary forms of low altitude downdraft phenomena in the microburst problem. GRA

N91-13048 Royal Netherlands Meteorological Inst., De Bilt. Physical Meteorology Dept.
OBJECTIVE ANALYSIS OF PRECIPITATION OBSERVATIONS DURING THE CHERNOBYL EPISODE
M. P. Scheele and G. H. L. Verver 1990 17 p
(KNMI-TR-122; ISSN-0169-1708; ETN-90-97651) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, Netherlands

For the international model evaluation study ATMES (Atmospheric Transport Model Evaluation Study) precipitation observations from 25 Apr. - 10 May 1986 are analyzed. The measurements that are used are in most cases observations of precipitation accumulated over 12 hours and sometimes over 6 hours. An algorithm is developed that estimates precipitation amounts at a synoptic station accumulated over 3 hours based on these observations. Synoptic codes are used to interpolate the precipitation measurements in time. The values thus obtained are interpolated to a grid using a Cressman(2,3) optimal interpolation scheme for a grid of approximately 65 by 65 km. For ATMES, precipitation amounts on a grid, accumulated over 6 hours,

are generated. The 6 hour resolution produced by this scheme is a better estimate than simply assuming equal precipitation amounts in each 6 hours. ESA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N91-13049# Beleidscommissie Remote Sensing, Delft (Netherlands).
KOPSTUDIE BLASER (LASER BATHYMETRY) Executive Summary, Jan. - Jun. 1989
Feb. 1990 132 p Prepared in cooperation with Fokker B.V., Amsterdam, Netherlands; Van Rietschoten and Houwens B.V., Rotterdam, Netherlands; and Oldelft B.V., Delft, Netherlands
(BCRS-89-36; ETN-90-97685) Avail: NTIS HC/MF A07

The project study on airborne Laser Bathymetry (BLASER) is summarized. It is to be applied in a North Sea oriented laser bathymetry system. The main objectives are: to generate a preliminary compilation of identifiable user requirements; to perform preliminary investigation into the BLASER commercial potential; to familiarize industries with BLASER technical/physical, project execution. The present volume contains the executive summary, the user requirement document, the technical problem analysis, and the final report. The technical complexity of the airborne laser bathymetry warrants an overall time frame of 6 years for a new development. The market survey does not allow an impact on either system requirements or project technical approach. A survey of the North Sea related data is provided. The feasibility of laser bathymetry in terms of penetration depth is limited to areas that lie at least 10 to 20 km off-shore. ESA

N91-13050# Woods Hole Oceanographic Inst., MA.
AN EXPLORATION OF THE NORTH ATLANTIC CURRENT AND ITS RECIRCULATION IN THE NEWFOUNDLAND BASIN USING SOFAR FLOATS
W. Brechner Owens and Marguerite E. Zemanovic Jul. 1990 151 p
(Contracts N00014-82-C-0019; N00014-84-C-0278; N00014-89-J-1184)
(AD-A226475; WHOI-90-32) Avail: NTIS HC/MF A08 CSCL 08/3

Trajectories and time series of velocity, temperature, and pressure are presented for 13 neutrally-buoyant, acoustically tracked (SOFAR) floats that were launched in May and June, 1986 in the Newfoundland Basin by the Woods Hole Oceanographic Institution SOFAR float operations group. The deployment of these floats and the array of Autonomous Listening Stations (ALS's) used to track the floats was designed to investigate the North Atlantic Current and its possible recirculation. Although there were a number of technical difficulties which reduced the data return for this experiment, we have obtained a total of nearly 12 years of float data for the region at three depths, nominally 700, 1200, and 2000m. The data obtained from two deployments of ALS's, covering nearly three years, are presented in this report. Of particular note is the strong eddy variability at 700m depth that is comparable to those found in the Gulf Stream Extension and the entrainment of 2000m depth floats into the deep western boundary current. GRA

N91-13000# Bundeswehr fuer Wasserschall- und Geophysik, Kiel (Germany, F.R.).
WATER SURFACE TEMPERATURES FROM THERMAL SATELLITE IMAGES [WASSEROBERFLAECHENTEMPERATUREN AUS THERMISCHEN SATELLITENBILDERN]
Peter L. Lobemeier *In* DLR, Proceedings of the 6th User Seminar of the German Remote Sensing Data Center of the DLR Mar. 1990 p 53-57 In GERMAN Original contains color illustrations (For primary document see N91-12992 04-43)
Avail: NTIS HC/MF A05; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany HC 42.50 Deutsche marks

51 LIFE SCIENCES (GENERAL)

N91-13051*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
SPACE AND BIOTECHNOLOGY: AN INDUSTRY PROFILE
Richard S. Johnston, David J. Norton, and Baldwin H. Tom Nov. 1988 93 p
(Contract NCC9-16)
(NASA-CR-187034; NAS 1.26:187034) Avail: NTIS HC/MF A05 CSCL 06C

The results of a study conducted by the Center for Space and Advanced Technology (CSAT) for NASA-JSC are presented. The objectives were to determine the interests and attitudes of the U.S. biotechnology industry toward space biotechnology and to prepare a concise review of the current activities of the biotechnology industry. In order to accomplish these objectives, two primary actions were taken. First, a questionnaire was designed, reviewed, and distributed to U.S. biotechnology companies. Second, reviews of the various biotechnology fields were prepared in several aspects of the industry. For each review, leading figures in the field were asked to prepare a brief review pointing out key trends and current industry technical problems. The result is a readable narrative of the biotechnology industry which will provide space scientists and engineers valuable clues as to where the space environment can be explored to advance the U.S. biotechnology industry. Author

N91-13052*# Lockheed Engineering and Sciences Co., Washington, DC.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 28
Lydia Razran Stone, ed., Ronald Teeter, ed., and Joseph Rowe, ed. (Library of Congress, Washington, DC.) Washington NASA Nov. 1990 142 p
(Contract NASw-4292)
(NASA-CR-3922(33); NAS 1.26:3922(33)) Avail: NTIS HC/MF A07 CSCL 06C

This is the twenty-eighth issue of NASA's Space Life Sciences Digest. It contains abstracts of 60 journal papers or book chapters published in Russian and of 3 Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. The abstracts in this issue have been identified as relevant to 20 areas of space biology and medicine. These areas include: adaptation, aviation medicine, botany, cardiovascular and respiratory systems, developmental biology, endocrinology, enzymology, equipment and instrumentation, hematology, human performance, immunology, life support systems, mathematical modeling, musculoskeletal system, neurophysiology, personnel selection, psychology, radiobiology, reproductive system, and space medicine. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N91-13053# Research Triangle Inst., Research Triangle Park, NC.
MEASUREMENTS OF EXHALED BREATH USING A NEW PORTABLE SAMPLING METHOD
E. D. Pellizzari, K. W. Thomas, J. H. Raymer, D. J. Smith, and S. D. Cooper Jul. 1990 313 p Sponsored by EPA, Research Triangle Park, NC
(Contract EPA-68-02-4544)

(PB90-250135; EPA/600/3-90/049) Avail: NTIS HC/MF A14 CSCL 06P

Breath measurements offer the potential for a direct and noninvasive evaluation of human exposure to volatile organic compounds (VOCs) in the environments in which people live and work. The research study was conducted to further develop the potential of this exposure assessment methodology. A new alveolar breath measurement technique was developed and tested. Air samples were collected in 32 microenvironments and above 6 consumer products to determine a few potential sources of human exposure to selected VOCs. Elimination half-lives were estimated using a mono- and biexponential model. The alveolar breath collection and analysis methodology proved to be very useful for collecting many samples in short time intervals and this capability was very important for accurately describing the initial phase of the decay curves. Analysis of microenvironment samples from homes, businesses, workplaces, vehicles, etc., revealed a wide range of potential sources of human exposures to VOCs at concentrations from 1 to 16,000 micro-g/cu m. GRA

N91-13054# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

INFLUENCE OF COLD EXPOSURE ON VENTILATION, RESPIRATORY HEAT LOSS, AND PULMONARY DEPOSITION/CLEARANCE Ph.D. Thesis

Donald A. Diesel Jun. 1990 170 p

(AD-A224680; AFIT/CI/CIA-90-021D) Avail: NTIS HC/MF A08 CSCL 06/3

Possible thermoregulatory benefits of cold-induced changes in breathing pattern (hypoventilation) and the mechanism(s) by which cold stimulates a change in breathing pattern were investigated in male Holstein calves 1 to 3 months old. Effects of ambient temperatures (Ta) between 4 and 18 C on ventilatory parameters and respiratory heat loss were determined in 4 calves. As Ta decreased, respiratory frequency decreased 29 percent while tidal volume increased 35 percent. Total ventilation (VE) did not change significantly, but the ventilatory equivalent for O2 decreased with decreasing Ta. Calves were capable of conserving respiratory heat during cold exposure by decreasing expired air temperature and by decreasing dead space ventilation while increasing O2 extraction. Hypoventilation is suggested as a mode of heat conservation in cold environments in animals which use panting as a means of increasing evaporative heat loss. The effect of cold-induced hypoventilation on pulmonary particle deposition was investigated in 10 calves. Deposition of nasally-instilled fluorescent Pasteurella haemolytica was significantly higher for cold-exposed calves. It is speculated that the cold-induced respiratory pattern change was responsible. Nasal mucus velocity (NMV) was measured in four unanesthetized calves at Ta = 2 to 4 C and Ta = 16 to 18 C, using a radiographic tracking technique. NMV was 24 percent lower during cold exposure. It is possible that cold-exposure decreases tracheal mucociliary clearance rate. GRA

N91-13055# Northwestern Univ., Evanston, IL.

ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL (1988). CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 2: SIMPLE AND PARTIAL CORRELATION TABLES-MALE Final Report, 1 Apr. 1989 - 31 Mar. 1990

James Cheverud, Claire C. Gordon, Robert A. Walker, Cashell Jacquish, and Luci Kohn May 1990 268 p

(Contract DAAK60-89-C-1006)

(AD-A224987; NATICK-TR-90/033) Avail: NTIS HC/MF A12 CSCL 05/9

The tables in this volume include the simple and partial correlation values among the 180 anthropometric variables analyzed and their correlations with age. The full correlation matrix, with 181 rows and 181 columns (one row and column for each variable) is provided so that all of the correlations for any single variable can be found on contiguous pages. The simple and partial correlation tables are: Male simple correlations; Male partial correlation -- stature, weight, stature and weight, and stature, weight and age. GRA

N91-13056# Northwestern Univ., Evanston, IL.

ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL (1988). CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 3: SIMPLE AND PARTIAL CORRELATION TABLES-FEMALE Final Report, 1 Apr. 1989 - 31 Mar. 1990

James Cheverud, Claire C. Gordon, Robert A. Walker, Cashell Jacquish, and Luci Kohn May 1990 267 p

(Contract DAAK60-89-C-1006)

(AD-A224988; NATICK-TR-90/034) Avail: NTIS HC/MF A12 CSCL 05/9

Included are the simple and partial correlation tables for females. The partial correlation tables include stature; weight; stature and weight; and stature, weight, and age. B.G.

N91-13057# Northwestern Univ., Evanston, IL.

ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL (1988). CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 4: BIVARIATE REGRESSION TABLES Final Report, 1 Apr. 1989 - 31 Mar. 1990

James Cheverud, Claire C. Gordon, Robert A. Walker, Cashell Jacquish, and Luci Kohn May 1990 317 p

(Contract DAAK60-89-C-1006)

(AD-A224989; NATICK-TR-90/035) Avail: NTIS HC/MF A14 CSCL 05/9

The tables in this volume contain the simple bivariate regression results, firstly for the males and secondly for the females. A separate listing is provided for each dependent variable. For each dependent variable, all bivariate regressions associated with correlations greater than 0.50 (or coefficients of determination greater than 0.25) are listed. Others, while statistically significant, are considered unreliable for dependent variable value prediction and are therefore not included. All of the regressions reported are statistically significant at the 0.001 level. All variables were analyzed on the millimeter scale, except for weight which is measured to the nearest 0.1 kilogram, so that the constant and standard error of the estimate are given in millimeters. GRA

N91-13058# Northwestern Univ., Evanston, IL.

ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL (1988). CORRELATION COEFFICIENTS AND REGRESSION EQUATIONS. PART 5: STEPWISE AND STANDARD MULTIPLE REGRESSION TABLES Final Report, 1 Apr. 1989 - 31 Mar. 1990

James Cheverud, Claire C. Gordon, Robert A. Walker, Cashell Jacquish, and Luci Kohn May 1990 138 p

(Contract DAAK60-89-C-1006)

(AD-A224990; NATICK-TR-90/036) Avail: NTIS HC/MF A07 CSCL 05/9

Stepwise multiple regression tables are provided separately for males and females. Each table contains a listing for a series of regression equations for each dependent variable. Each dependent variable is first identified by data base number, abbreviated name, and full name. For each listing five columns are presented, each giving the regression constant and coefficient(s) for the best predictive multiple regression including 1, 2, 3, 4, and 5 independent variables, respectively. The last two rows of each listing contain the standard error of the estimate and adjusted coefficient of determination (R-squared) for each of the five sequential models. All models are significantly different from zero at the 0.001 level. GRA

N91-13059# Los Alamos National Lab., NM. Life Sciences Div.

BEHAVIORAL EFFECTS OF 1300 MHz HIGH-PEAK-POWER MICROWAVE PULSED IRRADIATION Final Report, Jan. 1987 - Mar. 1988

Dennis L. Hjeresen, Robert F. Hoeberling, John Kinross-Wright, Kathryn O. Umberger, and B. Jon Klauenberg Aug. 1990 40 p Prepared in cooperation with School of Aerospace Medicine, Brooks AFB, TX

(AD-A226269; USAFSAM-TR-90-6) Avail: NTIS HC/MF A03 CSCL 05/8

Results of behavioral and physiological studies on the effects of high-peak-power microwaves (HPPM) are reported. Rats were

typically irradiated for 10 min using the following HPPM characteristics: 1300 MHz, 10 MW power, 5 and 10 pulses per second (pps), 1.8 kW/sq cm peak-power density with 1, 5, or 10 microseconds pulse widths. Average-power densities were 9, 45 and 90 mW/sq cm at 5 pps and 18, 90 and 180 mW/sq cm at 10 pps; average colonic Specific Absorption Rate (SAR) equals 1.8, 6.5, 13.1 W/kg and 3.6, 13.1, and 26.2 W/kg, respectively. Results indicated the following: (1) Irradiation under 10 microseconds/10 pps protocol (SAR = 26.2 W/kg) reduced locomotor activity; (2) Response rates under a variable-interval (VI) schedule declined after irradiation protocols yielding SARs greater than 13.1 W/kg. Author

N91-13060# California Univ., Irvine. Dept. of Information and Computer Science.
A SHORT REVIEW OF HUMAN MOTOR BEHAVIOR: PHENOMENA, THEORIES, AND SYSTEMS Interim Report, Apr. - Sep. 1989
Wayne Iba Jul. 1990 24 p
(Contract MDA903-85-C-0324)
(AD-A226271; UCI-ICS-TR-89-34; ARI-RN-90-55) Avail: NTIS HC/MF A03 CSCL 05/8

In this paper we survey three facets of human motor behavior-phenomena, theories, and implementations. We are particularly concerned with motor behavior that exhibits improvements over time and practices; this is referred to as human motor learning. We begin by discussing both performance and learning phenomena that have been observed in laboratory situations. This is followed with a review of three prominent theories of human motor control from the psychological literature. The performance and learning phenomena serve as a foundation on which to compare these theories. Finally, we consider several implemented models of motor learning that have attended to constraints imposed either by the phenomena introduced earlier or by the physiological structure of the human neuromuscular system. From the material surveyed. We conclude that more research on computational model would help answer in human motor behavior. GRA

N91-13061# Southwest Research Inst., San Antonio, TX.
FEASIBILITY OF NMR DETECTION OF DECOMPRESSION BUBBLES Final Report, Oct. 1985 - Nov. 1987
William L. Rollwitz Jul. 1990 58 p
(Contract F33615-83-D-0602; AF Proj. 7930)
(AD-A226323; USAFSAM-TP-89-22) Avail: NTIS HC/MF A04 CSCL 06/4

The reported program had four tasks: (1) construct the bubble generator and modify the NMR equipment to contain it; (2) make the NMR measurements and determine T11, T12, and T2 in blood samples both with and without bubbles of oxygen, air, and nitrogen; and (3) obtain a magnetic resonance image (MRI) of the knee and calculate the values of T1 and T2 in the synovial fluid in the knee. All of these tasks were completed. The bubble generator and the equipment modifications were made, tested successfully, and used to make two sets of NMR measurements on 25 samples of blood, in one sample of plasma and in two samples of water. Each sample had one of the following conditions: oxygen tonometer, oxygen bubbles, air tonometer, air bubbles, nitrogen tonometer, or nitrogen bubbles. In addition, some NMR measurements were made with flowing bubbles. From the NMR data, the relaxation times T2, T11, and T12 were calculated. Two references were found which reported data that showed that the value of T2 varied directly with the percent oxyhemoglobin and this condition was verified by the NMR measurements. From the data, it was concluded that it was feasible to use NMR measurements in blood to indicate the difference between fixed oxygen bubbles, fixed air bubbles, and fixed or flowing nitrogen bubbles in blood. GRA

N91-13062# Midwest Research Inst., Kansas City, MO.
FURTHER STUDIES OF 60 Hz EXPOSURE EFFECTS ON HUMAN FUNCTION
Charles Graham and Harvey D. Cohen Oct. 1990 6 p
(Contract DE-FG01-89CE-34025)
(DE91-000868; DOE/CE-34025/T5) Avail: NTIS HC/MF A02

Public concern has been expressed about possible health risks arising from exposure to the electric and magnetic fields generated power distribution systems. This project is addressing this concern through a laboratory research program designed to evaluate the effects of brief exposure to known field conditions on multiple measures of human function. In previous research, we found that exposure had statistically significant effects on physiological measures of cardiac and brain activity, and on performance measures of reaction time and performance accuracy. Effects were seen more clearly under intermittent exposure conditions, and at certain levels of electric and magnetic field strength. In this continuation effort, we are performing a series of exploratory studies, to be followed by a confirmatory experiment, to determine if the above physiological effects differ as a function of exposure to the electric and magnetic fields separately and combined, time of day, and rate of intermittent exposure. Further studies will explore the mechanisms underlying these effects. The information developed in this project will be of value in risk assessment activities, and in basic research aimed at identifying specific factors involved in the interaction of power line fields with the human system. In this reporting period our goals were to: (1) continue performance of the probe studies; (2) participate in a site visit at MRI; (3) request 1991 research continuation funding; and (4) submit an abstract of project findings for presentation at the 1990 DOE Contractors Review Meeting. DOE

N91-13063* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 342)
Nov. 1990 81 p
(NASA-SP-7011(342); NAS 1.21:7011(342)) Avail: NTIS HC A05; NTIS standing order as PB90-912300, $11.50 domestic, $23.00 foreign CSCL 06E

This bibliography lists 208 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during October 1990. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N91-13064# Naval Medical Research Inst., Bethesda, MD.
EFFECTS OF HAND AND FOOT HEATING ON DIVER THERMAL BALANCE Technical Report, 1988 - 1989
Robert P. Weinberg and Edward D. Thalmann May 1990 50 p
(AD-A226430; NMRI-90-52) Avail: NTIS HC/MF A03 CSCL 23/5

Divers at rest immersed in cold water for long durations wearing passive thermal protection garments are limited by low finger and toe temperatures, which cause pain and numbness before rectal temperatures fall to unsafe levels. It was reasoned that low levels of hand and foot heating might improve diver comfort. Supplemental heating of the hands and feet to maintain finger and toe temperatures between 12 and 18 C (after passive cooling) was employed. A total of 32 divers wearing a dry suit with M-600 Thinsulated undergarments were immersed for periods of up to 8 hours in 3 C water. The divers wore electrical resistance heated gloves and socks over polypropylene liners and under Thinsulated insulation, or warm-water-perfused gloves and socks over polypropylene liners and under foam neoprene insulation. Hands and feet remained dry by communication with the dry suit. Water perfusion rate or electrical power was adjusted to maintain desired digit temperatures. Supplemental heating did not reduce the need for adequate passive whole body thermal insulation for long-duration immersions in cold water. Supplemental heating did not reduce hand and foot discomfort at low energy cost, and reduced the decrement in manual dexterity compared to no heating. The low energy cost of resistance heating makes this feasible for immediate use by the Fleet. GRA

N91-13065# Civil Aeromedical Inst., Oklahoma City, OK.
RIGHT BUNDLE BRANCH BLOCK AS A RISK FACTOR FOR SUBSEQUENT CARDIAC EVENTS
Leslie S. Hudson, Charles F. Booze, Jr., and Audie W. Davis Aug. 1990 8 p
(AD-A226596; DOT/FAA/AM-90/7) Avail: NTIS HC/MF A02 CSCL 06/5

The identification of risk factors for adverse cardiac events is valuable to the certification of airmen. This study examines the importance of right bundle branch block (RBBB) as a risk for myocardial infarction (MI), atherosclerotic heart disease (ASHD) and coronary heart disease (CHD). Using a non-concurrent prospective design, 433 Class 1 airmen between the ages of 35 and 60 years who had an RBBB on their electrocardiogram (ECG) in 1970 were matched to 338 control Class 1 airmen who had no abnormalities on their 1970 ECG. Using the longitudinal database maintained by the Federal Aviation Administration (FAA), the medical records of these airmen were screened for MI, ASHD, and CHD through the end of 1985. Questionnaires were sent to airmen with incomplete data on the computerized database. The first occurrence of any of these outcomes was considered an adverse cardiac event. In the case group, 24 cardiac events occurred (3.93/1,000 person-years) compared with 9 events in the control group (1.87/1,000 person-years). The relative risk was 2.012 with 95 percent confidence intervals of .994 to 4.484. The findings suggest an increased risk of adverse cardiac events but are of borderline statistical significance. GRA

N91-12568# Wichita State Univ., KS. Dept. of Mechanical Engineering.
DYNAMIC BEHAVIOR OF THE HUMAN BODY SUBJECTED TO IMPACT CONDITIONS WITH AND WITHOUT RESTRAINT
Hamid Lankarani, Deren Ma, and Gayle Ermer *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 108-131 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N91-13066*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TECHNICAL ASPECTS OF A DEMONSTRATION TAPE FOR THREE-DIMENSIONAL SOUND DISPLAYS
Durand R. Begault and Elizabeth M. Wenzel Oct. 1990 22 p
(NASA-TM-102826; A-90162; NAS 1.15:102826) Avail: NTIS HC/MF A03 CSCL 05I

This document was developed to accompany an audio cassette that demonstrates work in three-dimensional auditory displays, developed at the Ames Research Center Aerospace Human Factors Division. It provides a text version of the audio material, and covers the theoretical and technical issues of spatial auditory displays in greater depth than on the cassette. The technical procedures used in the production of the audio demonstration are documented, including the methods for simulating rotorcraft radio communication, synthesizing auditory icons, and using the Convolvotron, a real-time spatialization device. Author

N91-13067# Retina Foundation, Boston, MA. Eye Research Inst.
EYE MOVEMENTS AND SPATIAL PATTERN VISION Annual Report, 1 May 1989 - 30 Apr. 1990
Lawrence E. Arend 15 Jul. 1990 13 p
(Grant AF-AFOSR-0377-89; AF Proj. 2313)
(AD-A225357; AFOSR-90-0810TR) Avail: NTIS HC/MF A03 CSCL 06/4

Models of human lightness and color perception must take account of color constancy, a tendency for apparent surface color to be relatively independent of the color and intensity of the illuminating light source. Our observers matched the lightness (apparent reflectances) and brightnesses (apparent luminances) of regions in simple and complex achromatic spatial patterns. The data showed that the observers' knowledge of the surface reflectances was unaffected by brightness changes due to varying illuminance. A third perceptual dimension, local brightness contrast, was different from both lightness and brightness. In further experiments we found that moving a patch from a black background to a white background could produce an error of apparent surface color of about 1.5 Munsell Value steps. Similar experiments at mesopic mean luminances revealed that the brightness contrast produced by a fixed luminance contrast declines with mean luminance. GRA

N91-13068# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
CONTROLLING SEARCH DYNAMICS BY MANIPULATING ENERGY LANDSCAPES
David S. Touretzky Dec. 1989 30 p Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678; NSF EET-87-16324)
(AD-A225719; AIP-111; CMU-CS-89-113) Avail: NTIS HC/MF A03 CSCL 05/8

Touretzky and Hinton's DCPS (Distributed Connectionist Production System) is a neural network with complex dynamical properties. Visualization of the energy landscapes of some of its component modules leads to a better intuitive understanding of the model. Three visualization techniques are examined. Analysis of the way energy landscapes change as modules interact during an annealing search suggests ways in which the search dynamics can be controlled, thereby improving the model's performance on difficult match cases. GRA

N91-13069# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE EFFECT OF INDEXING ON THE COMPLEXITY OF OBJECT RECOGNITION Memorandum Report
W. Eric L. Grimson Apr. 1990 30 p
(Contracts N00014-86-K-0685; N00014-85-K-0124; DACA76-85-C-0010; NSF IRI-89-00267)
(AD-A225761; AI-M-1226) Avail: NTIS HC/MF A03 CSCL 12/9

Many current recognition systems use constrained search to locate objects in cluttered environments. Previous formal analysis has shown that the expected amount of search is quadratic in the number of model and data features, if all the data is known to come from a single object, but is exponential when spurious data is included. If one can group the data into subsets likely to have come from a single object, then terminating the search once a good enough interpretation is found reduces the expected search to cubic. Without successful grouping, terminated search is still exponential. These results apply to finding instances of a known object in the data. In this paper, we turn to the problem of selecting models from a library, and examine the combinatorics of determining that a candidate object is not present in the data. We show that the expected search is again exponential, implying that naive approaches to indexing are likely to carry an expensive overhead, since an exponential amount of work is needed to weed out each of the incorrect models. The analytic results are shown to be in agreement with empirical data for cluttered object recognition. GRA

N91-13070# Chicago Univ., IL. Center for Decision Research.
DECISION MAKING UNDER UNCERTAINTY: THE EFFECTS OF ROLE AND AMBIGUITY Technical Report No. 25, 15 Mar. - 14 Jun. 1990
Robin M. Hogarth and Howard Kunreuther (Pennsylvania State Univ., University Park.) May 1990 45 p Revised Sponsored by NSF and Sloan Foundation
(Contract N00014-84-C-0018; NR Proj. RR0-4209)
(AD-A225771) Avail: NTIS HC/MF A03 CSCL 05/1

In many important decisions, people are uncertain or ambiguous

concerning the magnitude of the probabilities of events that can affect outcomes. The classic theory of decision making argues that people's decisions should not be affected by whether knowledge of a probability is precise or ambiguous. This chapter presents a descriptive model of how people cope with ambiguous probabilities in decision making. The model predicts that ambiguity matters. 'Decision weights' associated with ambiguous probabilities are assumed to be reached via an anchoring-and-adjustment process in which people anchor on an estimate of the probability and then adjust this as a result of mentally stimulating alternative values of the probability. The mental simulation process is affected by both the amount of ambiguity and whether outcomes are large or small gains and/or losses. One important factor that determines people's attitudes toward ambiguity is the nature of the role they assume in making decisions. GRA

N91-13071# Haifa Univ. (Israel).
ENHANCING PERFORMANCE UNDER STRESS BY INFORMATION ABOUT ITS EXPECTED DURATION Final Report, Feb. 1988 - Feb. 1989
Shlomo Breznitz Jul. 1990 28 p
(Contract DAJA45-86-C-0048)
(AD-A225889; ARI-RN-90-36) Avail: NTIS HC/MF A03 CSCL 05/8

For this report, the effect of False Short and False Long Information (with subsequent correction) on endurance of the Cold Pressor Test (CPT) was studied using more extreme information manipulations than the ones tested during the first year. On the basis of a specific experiment that investigated hand effects and order effects in the CPT paradigm, it was possible to use a combined between- and within-subjects design. Endurance in the False Short condition was significantly higher than in the False Long one. In another experiment, most subjects endured the pain longer in the No Control than in the Control conditions. The implications of these results to military situations were discussed. A pilot field experiment with marching soldiers tested some of the above factors in a real-life military context. False Long information at the start of the march led to significant breakdown under the strain. GRA

N91-13072# Army Armament Research and Development Command, Dover, NJ. Fire Support Armament Center.
METHODS FOR IDENTIFYING OBJECT CLASS, TYPE, AND ORIENTATION IN THE PRESENCE OF UNCERTAINTY
Russell Taylor, Anthony P. Reeves, and Frank P. Kuhl Aug. 1990 37 p
(AD-A225984; ARFSD-TR-90007) Avail: NTIS HC/MF A03 CSCL 12/9

Techniques are presented for identifying unoccluded three-dimensional objects from arbitrary viewing angles in the framework of a model-based feature vector classification scheme. Fourier descriptors and moments are used for feature vector generation from contour imagery and silhouette and/or range imagery, respectively. A class of objects, airplanes, is defined with six distinct example types in our test data set. An additional data set of four objects from this class is also defined. A method for generating an exhaustive set of library views and worst case test views has been developed using a polyhedral approximation to a sphere. Based on matching to this library, object class membership, type, and orientation are determined. An approach called classification quality assessment (CQA) is applied to this recognition paradigm to both assess and deal with uncertainty. This is a two level process: the first rejects objects that are not members of a known class and therefore not contained in the model database, while the second identifies the likelihood of error for classification of known object type and/or orientation (within class errors). Both use simple measures that were generated solely from the system's priori knowledge. GRA

N91-13073# Signal Analytics Corp., Vienna, VA.
A METHOD OF ANALYZING AIR SYSTEM PERFORMANCE BASED ON SHAPE DISTORTION Final Report, 24 Aug. 1989 - 30 Apr. 1990
Michael Steven Mort 5 May 1990 61 p
(Contract DAAL03-89-C-0033)
(AD-A226193; GF006-F; ARO-26842.1-EL-SBI) Avail: NTIS HC/MF A04 CSCL 12/9

This research developed a measure, called the Maximum Resolvable Polygon (MRP), which estimates the degree of shape distortion introduced by an imaging system. The MRP relies on a computer simulation of the imaging system. While such a computer simulation requires more extensive computer power than the computation of an analytical formula like the MRT, the MRP may still be considered relatively easy to compute. All software simulations and experiments reported were performed on a personal computer. A new test pattern set is n proposed to replace the bar pattern which is used to analyze the performance of man-in-the-loop systems. Target-like test patterns rely on the use of regular polygons and are parameterized by the number of sides in the polygons. Clutter-like objects are also derived from this test pattern set. A theoretical analysis of the MRP indicates that it estimates the target shape conditions at which a target recognition system will produce a 50 percent error rate. Simulation experiments have compared the performance which the MRP measure predicts that an automatic target recognition system would have with the performance of the human visual pattern recognition system. GRA

N91-13074# Amherst Systems, Inc., Buffalo, NY. Dept. of Electrical and Computer Engineering.
FOVEAL MACHINE VISION SYSTEMS Ph.D. Thesis
Cesar Bandera 1 Aug. 1990 293 p
(Contract DASG60-89-C-0075)
(AD-A226274; Rept-605-9160001) Avail: NTIS HC/MF A13 CSCL 12/9

This work presents a new class of active machine vision systems, called foveal machine vision systems, which feature space variant sampling directed by gaze strategies. Two families of space variant sampling geometries are analyzed with spatial resolution decreasing with distance from the optical axis. One family features a linear acuity roll-off, and the other an exponential roll-off. Techniques are presented for the integration of sensor frames into unified static scene perceptions. Foveal systems can use many existing hierarchical processing techniques, in particular image pyramid structures and algorithms. A hierarchical structure called the foveal polygon is described. The foveal polygon is the subset of an image pyramid supported by foveal sensor frame. Top-down (coarse-to-fine) algorithms processing polygon data serve as drivers for gaze control. Additional gaze control strategies are presented for general learning and surveying (minimization of hypothesis entropy), and feature interrogation (hypothesis likelihood maximization). GRA

N91-13075# Rochester Univ., NY. Center for Visual Science.
PERIPHERAL LIMITATIONS ON SPATIAL VISION Interim Report, 1 Aug. 1989 - 31 Jul. 1990
David R. Williams 16 Jul. 1990 10 p
(Grant AF-AFOSR-0292-88; AF Proj. 2313)
(AD-A226335; AFOSR-90-0877TR) Avail: NTIS HC/MF A02 CSCL 06/4

This project employs psychophysical techniques to examine the limitations on spatial vision imposed by the first stages in the visual pathway. Many of the experiments capitalize on laser interferometry, which allows sinusoidal gratings to be formed on an observer's retina that are immune to optical blurring. The appearance of very high frequency gratings is distorted, or aliased, by the cone mosaic. Such moire patterns provide the basis for psychophysical techniques to assess the topography of the cone mosaic in the living eye. These measurements, accompanied by measurements of visual acuity clarify the relationship between cone spacing and resolution. Resolution was also measured under conditions in which only the M or L cones could detect the interference fringe. A small difference in visual acuity than it was when both cone types detected the grating, showing that resolution is immune to photoreceptor loss under these circumstances. An aliasing phenomenon caused by spatial sampling by M and L

cones was also established. Interferometry also allows measurements of the optical quality of the eye, and a viable experimental design was established to estimate the off axis optical quality of the eye. GRA

N91-13328*# Montclair State Coll., Upper Montclair, NJ. Dept. of Psychology.
OPERATIONAL TESTING OF A FIGURE OF MERIT FOR OVERALL TASK PERFORMANCE
Moira LeMay *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 79-80 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 05I

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N91-12685# Ferranti Defence Systems Ltd., Edinburgh (Scotland).
PILOT MONITORING OF DISPLAY ENHANCEMENTS GENERATED FROM A DIGITAL DATA BASE
Peter J. Bennett and John J. Cockburn *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 7 p (For primary document see N91-12682 04-08)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-12693# Royal Aircraft Establishment, Farnborough (England).
RESEARCH INTO A MISSION MANAGEMENT AID
J. R. Catford and I. D. Gray (Ferranti Ltd., Chadderton, England) *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 10 p (For primary document see N91-12682 04-08)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N91-13076# California Univ., Irvine. Dept. of Information and Computer Science.
AN INTEGRATED COGNITIVE ARCHITECTURE FOR AUTONOMOUS AGENTS Final Report, Jul. 1988 - Jun. 1989
Pat Langley, Kevin Thompson, Wayne Iba, John H. Gennari, and John A. Allen Jul. 1990 50 p
(Contract MDA903-85-C-0324)
(AD-A225701; ARI-RN-90-48) Avail: NTIS HC/MF A03 CSCL 12/6

This report describes ICARUS, a cognitive architecture designed to control the behavior of an integrated intelligent agent. The framework assumes that all long-term knowledge is organized in a probabilistic concept hierarchy, that heuristic classification is the central performance mechanism, and that a process of concept formation underlies all learning. The three components of ICARUS are described and related to other cognitive architectures. GRA

N91-13077# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE SUPERCOMPUTER TOOLKIT AND ITS APPLICATIONS Memorandum Report
Harold Abelson, Andrew A. Berlin, Jacob Katzenelson, William H. McAllister (Hewlett-Packard Co., Palo Alto, CA.), Guillermo J. Rozas, and Gerald Jay Sussman Jul. 1990 17 p Presented at the 5th Jerusalem Conference on Information Technology, Oct. 1990
(Contract N00014-89-J-3202)
(AD-A225807; AI-M-1249) Avail: NTIS HC/MF A03 CSCL 12/6

The Superconductor Toolkit is a proposed family of standard hardware and software components from which special-purpose machines can be easily configured. Using the toolkit, a scientist or an engineer, starting with a suitable computational problem, will be able to readily configure a special purpose multiprocessor that attains supercomputer-class performance on that problem, at a fraction of the cost of a general purpose supercomputer. GRA

N91-13078# Naval Underwater Systems Center, Newport, RI.
AFTER-ACTION REPORT FOR THE NEXT-GENERATION COMPUTER RESOURCES (NGCR) OPERATING SYSTEMS INTERFACE STANDARD BASELINE SELECTION PROCESS Final Report
J. T. Oblinger, comp. 1 Jun. 1990 29 p Sponsored by Space and Naval Warfare Systems Command, Washington, DC
(AD-A225833; NUSC-TD-6904) Avail: NTIS HC/MF A03 CSCL 12/7

The Next-Generation Computer Resources (NGR) Operating Systems Standards Working Group (OSSWG) conducted a survey of existing operating systems and operating systems interface standards to establish a baseline for the NGCR operating system interface (OSIF). The first section of this report describes the purpose and scope of this study, which covered the timeframe from March 1989 (a briefing made to industry) to April 1990 (when the OSIF baseline was selected). The second section discusses issues regarding the OSSWG evaluation process. Issues presented include the benefits OSSWG gained by active industry participation, the effectiveness of the electronic mail system for providing communications between meetings, the concerns about the compressed schedule, and a discussion about the difficulty in interpreting the evaluation scores. The third section addresses the technical issues that caused difficulties for OSSWG in achieving its objectives. Some of these include (1) how to define distributed technology within an operating system interface; (2) how to specify security; (3) how security impacts the technology of real-time capabilities, distribution, and fault-tolerance; and (4) to what extent

OSIF issues impact the performance of OS implementations. The technology topics in this section are presented as technology shortfall areas where there is need for additional research. GRA

N91-13079# Technische Univ., Darmstadt (Germany, F.R.). Fachbereich Informatik.
THE INTEGRATED DISPLAY CONTROLLER, A NEW ARCHITECTURE Ph.D. Thesis [DER INTEGRIERTE DISPLAY CONTROLLER, EINE NEUE ARCHITEKTUR]
Juergen Staerk 1989 238 p In GERMAN
(ETN-90-98164) Avail: NTIS HC/MF A11

Raster graphics hardware systems, such as smart image memory display, a rectangular area filling display system, a scan line access memory system, and a pixel planes system, are reviewed. The integrated display controller which allows a lot of graphic operations such as a generation of axis parallel lines, zooming and panning, window-clipping, parallel generation of the same objects, at low cost, is described. The possible configurations of this controller are described. ESA

N91-13080# Institut National Polytechnique, Grenoble (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
THE ARCHITECTURE OF THE PAC COMPUTER ALGEBRA SYSTEM AND ITS RATIONAL ARITHMETIC Ph.D. Thesis [ARCHITECTURE DU SYSTEME PAC ET SON ARITHMETIQUE RATIONNELLE]
Jean-Louis Roch 1989 208 p In FRENCH; ENGLISH summary
(ETN-90-98204) Avail: NTIS HC/MF A10

The architecture of the Parallel Algebraic Computing (PAC) computer algebra system dedicated to a massively parallel computer is described. The description involves theoretical modelization of the polynomial product problem. The PAC system is implemented on the hypercube FPS-T40 (32 processors). The implementation of the rational infinite precision arithmetic kernel, available on each node, is discussed. Several algorithms are studied. New algorithms for multiplication, division and computation of any size integers are proposed and evaluated. A vectorization of basic arithmetic algorithms is proposed, and used experimentally. ESA

N91-12695*# Draper (Charles Stark) Lab., Inc., Cambridge, MA. Fault-Tolerant Systems Div.
A BYZANTINE RESILIENT PROCESSOR WITH AN ENCODED FAULT-TOLERANT SHARED MEMORY
Bryan Butler and Richard Harper *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 12 p (For primary document see N91-12682 04-08)
(Contract NAS1-18565)
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61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N91-13081*# Essex Corp., Orlando, FL.
USERS MANUAL FOR THE AUTOMATED PERFORMANCE TEST SYSTEM (APTS)
N. E. Lane and R. S. Kennedy 31 Jan. 1990 83 p
(Contract NAS9-17326; NSF ISI-85-21282)
(NASA-CR-185631; NAS 1.26:185631) Avail: NTIS HC/MF A05 CSCL 09B

The characteristics of and the user information for the Essex Automated Performance Test System (APTS) computer-based portable performance assessment battery are given. The battery was developed to provide a menu of performance test tapping the widest possible variety of human cognitive and motor functions, implemented on a portable computer system suitable for use in both laboratory and field settings for studying the effects of toxic agents and other stressors. The manual gives guidance in selecting, administering and scoring tests from the battery, and reviews the data and studies underlying the development of the battery. Its main emphasis is on the users of the battery - the scientists, researchers and technicians who wish to examine changes in human performance across time or as a function of changes in the conditions under which test data are obtained. First the how to information needed to make decisions about where and how to use the battery is given, followed by the research background supporting the battery development. Further, the development history of the battery focuses largely on the logical framework within which tests were evaluated. Author

N91-13082*# Auburn Univ., AL. Dept. of Computer Science and Engineering.
QUEST/Ada (QUERY UTILITY ENVIRONMENT FOR SOFTWARE TESTING OF Ada): THE DEVELOPMENT OF A PRGRAM ANALYSIS ENVIRONMENT FOR Ada, TASK 1, PHASE 2 Progress Report, 1 Jun. 1989 - 31 May 1990
David B. Brown Aug. 1990 188 p
(Contract NCC8-14)
(NASA-CR-186939; NAS 1.26:186939) Copyright Avail: NTIS HC/MF A09 CSCL 09B

The results of research and development efforts are described for Task one, Phase two of a general project entitled The Development of a Program Analysis Environment for Ada. The scope of this task includes the design and development of a prototype system for testing Ada software modules at the unit level. The system is called Query Utility Environment for Software Testing of Ada (QUEST/Ada). The prototype for condition coverage provides a platform that implements expert system interaction with program testing. The expert system can modify data in the instrument source code in order to achieve coverage goals. Given this initial prototype, it is possible to evaluate the rule base in order to develop improved rules for test case generation. The goals of Phase two are the following: (1) to continue to develop and improve the current user interface to support the other goals of this research effort (i.e., those related to improved testing efficiency and increased code reliable); (2) to develop and empirically evaluate a succession of alternative rule bases for the test case generator such that the expert system achieves coverage in a more efficient manner; and (3) to extend the concepts of the current test environment to address the issues of Ada concurrency. Author

N91-13083*# Auburn Univ., AL. Dept. of Computer Science and Engineering.
GRASP/Ada (GRAPHICAL REPRESENTATIONS OF ALGORITHMS, STRUCTURES, AND PROCESSES FOR Ada): THE DEVELOPMENT OF A PROGRAM ANALYSIS ENVIRONMENT FOR Ada. REVERSE ENGINEERING TOOLS FOR Ada, TASK 1, PHASE 2 Progress Report, 1 Jun. 1989 - 31 May 1990
James H. Cross, II Aug. 1990 110 p
(Contract NCC8-14)
(NASA-CR-186940; NAS 1.26:186940) Copyright Avail: NTIS HC/MF A06 CSCL 09B

The study, formulation, and generation of structures for Ada (GRASP/Ada) are discussed in this second phase report of a three phase effort. Various graphical representations that can be extracted or generated from source code are described and categorized with focus on reverse engineering. The overall goal is to provide the foundation for a CASE (computer-aided software design) environment in which reverse engineering and forward engineering (development) are tightly coupled. Emphasis is on a subset of architectural diagrams that can be generated automatically from source code with the control structure diagram (CSD) included for completeness. Author

N91-13084*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
THE mGA1.0: A COMMON LISP IMPLEMENTATION OF A MESSY GENETIC ALGORITHM
David E. Goldberg and Travis Kerzic (Alabama Univ., Huntsville.) May 1990 52 p
(Contract NCC9-16)
(NASA-CR-187260; NAS 1.26:187260) Avail: NTIS HC/MF A04 CSCL 09B

Genetic algorithms (GAs) are finding increased application in difficult search, optimization, and machine learning problems in science and engineering. Increasing demands are being placed on algorithm performance, and the remaining challenges of genetic algorithm theory and practice are becoming increasingly unavoidable. Perhaps the most difficult of these challenges is the so-called linkage problem. Messy GAs were created to overcome the linkage problem of simple genetic algorithms by combining variable-length strings, gene expression, messy operators, and a nonhomogeneous phasing of evolutionary processing. Results on a number of difficult deceptive test functions are encouraging with the mGA always finding global optima in a polynomial number of function evaluations. Theoretical and empirical studies are continuing, and a first version of a messy GA is ready for testing by others. A Common LISP implementation called mGA1.0 is documented and related to the basic principles and operators developed by Goldberg et. al. (1989, 1990). Although the code was prepared with care, it is not a general-purpose code, only a research version. Important data structures and global variations are described. Thereafter brief function descriptions are given, and sample input data are presented together with sample program output. A source listing with comments is also included. Author

N91-13085*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
IDSE VERSION 1 USER'S MANUAL
Richard Mayer (Texas A&M Univ., College Station.) Nov. 1988 130 p
(Contract NCC9-16)
(NASA-CR-187755; NAS 1.26:187755) Avail: NTIS HC/MF A07 CSCL 09B

The integrated development support environment (IDSE) is a suite of integrated software tools that provide intelligent support for information modelling. These tools assist in function, information, and process modeling. Additional tools exist to assist in gathering and analyzing information to be modeled. This is a user's guide to application of the IDSE. Sections covering the requirements and design of each of the tools are presented. There are currently three integrated computer aided manufacturing definition (IDEF) modeling methodologies: IDEF0, IDEF1, and IDEF2. Also, four appendices exist to describe hardware and software requirements, installation procedures, and basic hardware usage. Author

N91-13086*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
AN INVESTIGATION OF MESSY GENETIC ALGORITHMS
David E. Goldberg, Kalyanmoy Deb, and Bradley Korb (Alabama Univ., Tuscaloosa.) May 1990 30 p
(Contract NCC9-16)
(NASA-CR-187268; NAS 1.26:187268) Avail: NTIS HC/MF A03 CSCL 09B

Genetic algorithms (GAs) are search procedures based on the mechanics of natural selection and natural genetics. They combine the use of string codings or artificial chromosomes and populations with the selective and juxtapositional power of reproduction and recombination to motivate a surprisingly powerful search heuristic in many problems. Despite their empirical success, there has been a long standing objection to the use of GAs in arbitrarily difficult problems. A new approach was launched. Results to a 30-bit, order-three-deception problem were obtained using a new type of genetic algorithm called a messy genetic algorithm (mGAs). Messy genetic algorithms combine the use of variable-length strings, a two-phase selection scheme, and messy genetic operators to effect a solution to the fixed-coding problem of standard simple GAs. The results of the study of mGAs in problems with nonuniform subfunction scale and size are presented. The mGA approach is summarized, both its operation and the theory of its use. Experiments on problems of varying scale, varying building-block size, and combined varying scale and size are presented. Author

N91-13087*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
SOFTWARE ENGINEERING AND THE ROLE OF Ada: EXECUTIVE SEMINAR
Glenn B. Freedman 31 May 1987 140 p Seminar held in Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187266; NAS 1.26:187266) Avail: NTIS HC/MF A07 CSCL 09B

The objective was to introduce the basic terminology and concepts of software engineering and Ada. The life cycle model is reviewed. The application of the goals and principles of software engineering is applied. An introductory understanding of the features of the Ada language is gained. Topics addressed include: the software crises; the mandate of the Space Station Program; software life cycle model; software engineering; and Ada under the software engineering umbrella. B.G.

N91-13088# Japan Atomic Energy Research Inst., Tokyo. Dept. of Reactor Engineering.
PALLAS-1D(V3): VARIABLE-DIMENSION VERSION OF PALLAS-1D(7)
Kiyoshi Takeuchi (Ship Research Inst., Tokyo, Japan) and Shun-Ichi Tanaka Mar. 1990 50 p
(DE90-513756; JAERI-M-90-041) Avail: NTIS (US Sales Only) HC A03

The PALLAS-1D(V3) program is a variable-dimension version of the PALLAS-1D(7) code, which is the revised version of the PALLAS-PL, SP-Br code. The PALLAS-1D(7) code could treat transport of both neutrons and gamma rays, in particular of secondary photons including the bremsstrahlung and annihilation photons. This document gives a full description of input and output data for PALLAS-1D(V3) code, also with the input description of several sample problems. DOE

N91-13089*# Houston Univ., Clear Lake, TX.
A REPORT ON NASA SOFTWARE ENGINEERING AND Ada TRAINING REQUIREMENTS Final Report
Sue LeGrand, Glenn B. Freedman, and L. Svabek 15 Nov. 1987 150 p Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187390; NAS 1.26:187390) Avail: NTIS HC/MF A07 CSCL 09B

NASA's software engineering and Ada skill base are assessed and information that may result in new models for software engineering, Ada training plans, and curricula are provided. A quantitative assessment which reflects the requirements for software engineering and Ada training across NASA is provided. A recommended implementation plan including a suggested curriculum with associated duration per course and suggested means of delivery is also provided. The distinction between education and training is made. Although it was directed to focus on NASA's need for the latter, the key relationships to software engineering education are also identified. A rationale and strategy for implementing a life cycle education and training program are detailed in support of improved software engineering practices and the transition to Ada. Author

N91-13090*# GHG Corp., Houston, TX.
AdaNET DYNAMIC SOFTWARE INVENTORY (DSI) PROTOTYPE COMPONENT ACQUISITION PLAN
Lionel Hanley May 1989 19 p Revised Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187309; NAS 1.26:187309) Avail: NTIS HC/MF A03 CSCL 09B

A component acquisition plan contains the information needed to evaluate, select, and acquire software and hardware components necessary for successful completion of the AdaNET Dynamic Software Inventory (DSI) Management System Prototype. This plan will evolve and be applicable to all phases of the DSI prototype development. Resources, budgets, schedules, and organizations related to component acquisition activities are provided. A purpose and description of a software or hardware component which is to be acquired are presented. Since this is a plan for acquisition of all components, this section is not applicable. The procurement activities and events conducted by the acquirer are described and who is responsible is identified, where the activity will be performed, and when the activities will occur for each planned procurement. Acquisition requirements describe the specific requirements and standards to be followed during component acquisition. The activities which will take place during component acquisition are described. A list of abbreviations and acronyms, and a glossary are contained. Author

N91-13091*# MountainNet, Dellslow, WV.
AdaNET EXECUTIVE SUMMARY
R. Michael Digman Aug. 1988 285 p Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187383; NAS 1.26:187383) Avail: NTIS HC/MF A13 CSCL 09B

The goal of AdaNET is to transfer existing and emerging software engineering technology from the Federal government to the private sector. The views and perspectives of the current project participants on long and short term goals for AdaNET; organizational structure; resources and returns; summary of identified AdaNET services; and the summary of the organizational model currently under discussion are presented. B.G.

N91-13092*# MountainNet, Dellslow, WV.
AdaNET RESEARCH PROJECT Final Report
R. Michael Digman Aug. 1988 183 p Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187389; NAS 1.26:187389) Avail: NTIS HC/MF A09 CSCL 09B

The components necessary for the success of the commercialization of an Ada Technology Transition Network are reported in detail. The organizational plan presents the planned structure for services development and technical transition of AdaNET services to potential user communities. The Business Plan is the operational plan for the AdaNET service as a commercial venture. The Technical Plan is the plan from which the AdaNET can be designed including detailed requirements analysis. Also contained is an analysis of user fees and charges, and a proposed user fee schedule. B.G.

N91-13093*# Softech, Inc., Houston, TX.
DATA MANAGEMENT SYSTEM (DMS) TESTBED USER'S MANUAL DEVELOPMENT, VOLUMES 1 AND 2
John G. McBride and Norman Cohen 31 Oct. 1986 98 p Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187391; NAS 1.26:187391) Avail: NTIS HC/MF A05 CSCL 09B

A critical review of the network communication services contained in the Tinman User's Manual for Data Management System Test Bed (Tinman DMS User's Manual) is presented. The review is from the perspective of applying modern software engineering principles and using the Ada language effectively to ensure the test bed network communication services provide a robust capability. Overall the material on network communication services reflects a reasonably good grasp of the Ada language. Language features are appropriately used for most services. Design alternatives are offered to provide improved system performance and a basis for better application software development. Section two contains a review and suggests clarifications of the Statement of Policies and Services contained in Appendix B of the Tinman DMS User's Manual. Section three contains a review of the Network Communication Services and section four contains concluding comments. Author

N91-13094*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
PC TOOLS FOR PROJECT MANAGEMENT: PROGRAMS AND THE STATE-OF-THE-PRACTICE
Peter C. Bishop, Glenn B. Freedman, Christopher J. Dede, William Lidwell, and David Learned Aug. 1990 116 p
(Contract NCC9-16)
(NASA-CR-187392; NAS 1.26:187392) Avail: NTIS HC/MF A06 CSCL 09B

The use of microcomputer tools for NASA project management; which features are the most useful; the impact of these tools on job performance and individual style; and the prospects for new features in project management tools and related tools are addressed. High, mid, and low end PM tools are examined. The pro's and con's of the tools are assessed relative to various tasks. The strengths and weaknesses of the tools are presented through cases and demonstrations. B.G.

N91-13095*# Softech, Inc., Houston, TX.
Ada/POSIX BINDING: A FOCUSED Ada INVESTIGATION
Sue LeGrand 17 Oct. 1988 16 p Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187398; NAS 1.26:187398) Avail: NTIS HC/MF A03 CSCL 09B

NASA is seeking an operating system interface definition (OSID) for the Space Station Program (SSP) in order to take advantage of the commercial off-the-shelf (COTS) products available today and the many that are expected in the future. NASA would also like to avoid the reliance on any one source for operating systems, information system, communication system, or instruction set architecture. The use of the Portable Operating System Interface for Computer Environments (POSIX) is examined as a possible solution to this problem. Since Ada is already the language of choice for SSP, the question of an Ada/POSIX binding is addressed. The intent of the binding is to provide access to the POSIX standard operation system (OS) interface and environment, by which application portability of Ada applications will be supported at the source code level. A guiding principle of Ada/POSIX binding development is a clear conformance of the Ada interface with the functional definition of POSIX. The interface is intended to be used by both application developers and system implementors. The objective is to provide a standard that allows a strictly conforming application source program that can be compiled to execute on any conforming implementation. Special emphasis is placed on first providing those functions and facilities that are needed in a wide variety of commercial applications Author

N91-13096*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
A STUDY OF SYSTEM INTERFACE SETS (SIS) FOR THE HOST, TARGET AND INTEGRATION ENVIRONMENTS OF THE SPACE STATION PROGRAM (SSP) Final Report
Charles McKay, David Auty, and Kathy Rogers (Rockwell International Corp., Houston, TX.) 30 Jun. 1987 96 p
(Contract NCC9-16)
(NASA-CR-187399; NAS 1.26:187399) Avail: NTIS HC/MF A05 CSCL 09B

System interface sets (SIS) for large, complex, non-stop, distributed systems are examined. The SIS of the Space Station Program (SSP) was selected as the focus of this study because an appropriate virtual interface specification of the SIS is believed to have the most potential to free the project from four life cycle tyrannies which are rooted in a dependance on either a proprietary or particular instance of: operating systems, data management systems, communications systems, and instruction set architectures. The static perspective of the common Ada programming support environment interface set (CAIS) and the

portable common execution environment (PCEE) activities are discussed. Also, the dynamic perspective of the PCEE is addressed. Author

N91-13097*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
A METHOD FOR TAILORING THE INFORMATION CONTENT OF A SOFTWARE PROCESS MODEL
Sharon Perkins and Mark B. Arend Jun. 1990 22 p
(Contract NCC9-16)
(NASA-CR-187400; NAS 1.26:187400) Avail: NTIS HC/MF A03 CSCL 09B

The framework is defined for a general method for selecting a necessary and sufficient subset of a general software life cycle's information products, to support new software development process. Procedures for characterizing problem domains in general and mapping to a tailored set of life cycle processes and products is presented. An overview of the method is shown using the following steps: (1) During the problem concept definition phase, perform standardized interviews and dialogs between developer and user, and between user and customer; (2) Generate a quality needs profile of the software to be developed, based on information gathered in step 1; (3) Translate the quality needs profile into a profile of quality criteria that must be met by the software to satisfy the quality needs; (4) Map the quality criteria to set of accepted processes and products for achieving each criterion; (5) Select the information products which match or support the accepted processes and product of step 4; and (6) Select the design methodology which produces the information products selected in step 5. Author

N91-13098*# Softech, Inc., Houston, TX.
STORAGE MANAGEMENT IN Ada. THREE REPORTS. VOLUME 1: STORAGE MANAGEMENT IN Ada AS A RISK TO THE DEVELOPMENT OF RELIABLE SOFTWARE. VOLUME 2: RELEVANT ASPECTS OF LANGUAGE. VOLUME 3: REQUIREMENTS OF THE LANGUAGE VERSUS MANIFESTATIONS OF CURRENT IMPLEMENTATIONS
David Auty 29 Jan. 1988 74 p Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16; Proj. RICIS SE-9)
(NASA-CR-187401; NAS 1.26:187401) Copyright Avail: NTIS HC/MF A04 CSCL 09B

The risk to the development of program reliability is derived from the use of a new language and from the potential use of new storage management techniques. With Ada and associated support software, there is a lack of established guidelines and procedures, drawn from experience and common usage, which assume reliable behavior. The risk is identified and clarified. In order to provide a framework for future consideration of dynamic storage management on Ada, a description of the relevant aspects of the language is presented in two sections: Program data sources, and declaration and allocation in Ada. Storage-management characteristics of the Ada language and storage-management characteristics of Ada implementations are differentiated. Terms that are used are defined in a narrow and precise sense. The storage-management implications of the Ada language are described. The storage-management options available to the Ada implementor and the implications of the implementor's choice for the Ada programmer are also described. B.G.

N91-13099*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
THE 28-ENTITY IGES TEST FILE RESULTS USING COMPUTERVISION CADDS 4X
Anchyi Kuan, Saurin Shah, and Kevin Smith Aug. 1987 39 p
(Contract NCC9-16)
(NASA-CR-187402; NAS 1.26:187402) Avail: NTIS HC/MF A03 CSCL 09B

The investigation was based on the following steps: (1) Read the 28 Entity IGES (Initial Graphics Exchange Specification) Test File into the CAD data base with the IGES post-processor; (2) Make the modifications to the displayed geometries, which should produce the normalized front view and the drawing entity defined display; (3) Produce the drawing entity defined display of the file as it appears in the CAD system after modification to the geometry; (4) Translate the file back to IGES format using IGES pre-processor; (5) Read the IGES file produced by the pre-processor back into the CAD data base; (6) Produce another drawing entity defined display of the CAD display; and (7) Compare the plots resulting from steps 3 and 6 - they should be identical to each other. Author

N91-13100*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
RECREATION OF THE 28-ENTITY IGES TEST FILE USING THE COMPUTERVISION CADDS 4X
Anchyi Kuan, Saurin Shah, and Kevin Smith Aug. 1987 73 p
(Contract NCC9-16)
(NASA-CR-187403; NAS 1.26:187403) Avail: NTIS HC/MF A04 CSCL 09B

An Initial Graphics Exchange Specification (IGES) test file is called the 28 Entity IGES Test File. This file contains 28 geometric and annotation entities which are considered the basic entities that an IGES translator for any CAD system should support. The main purpose was to determine how the IGES preprocessor supports the 28 entities through recreation of the 28 Entity IGES Test File on the ComputerVision CADDS 4X. Test procedure is described and test results are presented. Author

N91-13101*# GHG Corp., Houston, TX.
AdaNET PROTOTYPE LIBRARY ADMINISTRATION MANUAL
Lionel Hanley May 1989 22 p Revised Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187404; NAS 1.26:187404) Avail: NTIS HC/MF A03 CSCL 09B

The functions of the AdaNET Prototype Library of Reusable Software Parts is described. Adopted from the Navy Research Laboratory's Reusability Guidebook (V.5.0), this is a working document, customized for use the the AdaNET Project. Within this document, the term part is used to denote the smallest unit controlled by a library and retrievable from it. A part may have several constituents, which may not be individually tracked. Presented are the types of parts which may be stored in the library and the relationships among those parts; a concept of trust indicators which provide measures of confidence that a user of a previously developed part may reasonably apply to a part for a new application; search and retrieval, configuration management, and communications among those who interact with the AdaNET Prototype Library; and the AdaNET Prototype, described from the perspective of its three major users: the part reuser and retriever, the part submitter, and the librarian and/or administrator. Author

N91-13102*# GHG Corp., Houston, TX.
AdaNET PHASE 0 SUPPORT FOR THE AdaNET DYNAMIC SOFTWARE INVENTORY (DSI) MANAGEMENT SYSTEM PROTOTYPE. CATALOG OF AVAILABLE REUSABLE SOFTWARE COMPONENTS
Lionel Hanley May 1989 126 p Revised Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187405; NAS 1.26:187405) Avail: NTIS HC/MF A07 CSCL 09B

The Ada Software Repository is a public-domain collection of Ada software and information. The Ada Software Repository is one of several repositories located on the SIMTEL20 Defense Data Network host computer at White Sands Missile Range, and available to any host computer on the network since 26 November 1984. This repository provides a free source for Ada programs and information. The Ada Software Repository is divided into several subdirectories. These directories are organized by topic, and their names and a brief overview of their topics are contained. The Ada Software Repository on SIMTEL20 serves two basic roles: to promote the exchange and use (reusability) of Ada programs

and tools (including components) and to promote Ada education.
Author

N91-13103*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
EVALUATION OF THE TRAJECTORY OPERATIONS APPLICATIONS SOFTWARE TASK (TOAST). VOLUME 2: INTERVIEW TRANSCRIPTS
Sharon Perkins, Andrea Martin, and Bill Bavinger (Rice Univ., Houston, TX.) 27 Aug. 1990 147 p
(Contract NCC9-16)
(NASA-CR-187406; NAS 1.26:187406) Avail: NTIS HC/MF A07 CSCL 09B

The Trajectory Operations Applications Software Task (TOAST) is a software development project whose purpose is to provide trajectory operation pre-mission and real-time support for the Space Shuttle. The purpose of the evaluation was to evaluate TOAST as an Application Manager - to assess current and planned capabilities, compare capabilities to commercially-available off the shelf (COTS) software, and analyze requirements of MCC and Flight Analysis Design System (FADS) for TOAST implementation. As a major part of the data gathering for the evaluation, interviews were conducted with NASA and contractor personnel. Real-time and flight design users, orbit navigation users, the TOAST developers, and management were interviewed. Code reviews and demonstrations were also held. Each of these interviews was videotaped and transcribed as appropriate. Transcripts were edited and are presented chronologically. Author

N91-13104*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
EVALUATION OF THE TRAJECTORY OPERATIONS APPLICATIONS SOFTWARE TASK (TOAST)
Sharon Perkins, Andrea Martin, and Bill Bavinger (Rice Univ., Houston, TX.) 27 Aug. 1990 65 p
(Contract NCC9-16)
(NASA-CR-187408; NAS 1.26:187408) Avail: NTIS HC/MF A04 CSCL 09B

The Trajectory Operations Applications Software Task (TOAST) is a software development project under the auspices of the Mission Operations Directorate. Its purpose is to provide trajectory operation pre-mission and real-time support for the Space Shuttle program. As an Application Manager, TOAST provides an isolation layer between the underlying Unix operating system and the series of user programs. It provides two main services: a common interface to operating system functions with semantics appropriate for C or FORTRAN, and a structured input and output package that can be utilized by user application programs. In order to evaluate TOAST as an Application Manager, the task was to assess current and planned capabilities, compare capabilities to functions available in commercially-available off the shelf (COTS) and Flight Analysis Design System (FADS) users for TOAST implementation. As a result of the investigation, it was found that the current version of TOAST is well implemented and meets the needs of the real-time users. The plans for migrating TOAST to the X Window System are essentially sound; the Executive will port with minor changes, while Menu Handler will require a total rewrite. A series of recommendations for future TOAST directions are included.
Author

N91-13105*# Digital Technology, Inc., Champaign, IL. Research Inst. for Computing and Information Systems.
AN IMPLEMENTATION AND ANALYSIS OF THE ABSTRACT SYNTAX NOTATION ONE AND THE BASIC ENCODING RULES
James D. Harvey and Alfred C. Weaver Aug. 1990 55 p
Prepared for Houston Univ., Clear Lake, TX
(Contract NCC9-16)
(NASA-CR-187409; NAS 1.26:187409) Avail: NTIS HC/MF A04 CSCL 09B

The details of abstract syntax notation one standard (ASN.1) and the basic encoding rules standard (BER) that collectively solve the problem of data transfer across incompatible host environments are presented, and a compiler that was built to automate their use is described. Experiences with this compiler are also discussed which provide a quantitative analysis of the performance costs associated with the application of these standards. An evaluation is offered as to how well suited ASN.1 and BER are in solving the common data representation problem. Author

N91-13106 Indian Inst. of Tech., Kanpur.
AN INTEGRATED CAD SYSTEM FOR DESIGN OF TESTABLE VLSI CIRCUITS Ph.D. Thesis
Sudipta Bhawmik 1989 334 p
Avail: Univ. Microfilms Order No. DA9016026

To tackle the current day testing complexity of very large scale circuits design for testability (DFT) is becoming more of a necessity. However very large scale integration (VLSI) designers are yet to accept DFT mainly due to lack of effective tools. Expert systems technology promises to be a useful means to present to the designer the gamut of DFT knowledge developed so far, primarily by test experts, in a more effective way. An original research is presented to develop a knowledge based expert system (DFTEXPERT) which provides the designer with expert assistance in designing testable VLSI chips. The basic approach taken is to configure testable structures in a given RTL circuit description utilizing the available circuit resources (like registers) and reconfiguring them to DFT structures (scan paths and linear feedback shift registers) using the basic rules of DFT. A formal optimization technique was proposed to control the chip area overhead resulting from the incorporation of DFT logic. Methods for scheduling the test application plans are presented using the constraint satisfaction techniques for increasing test throughput. A frame work for an integrated computer aided design (CAD) environment, based on object oriented programming (OOP) paradigm was also proposed. This environment treats the design entities and the design tools in an unified manner. The DFTEXPERT is one of the tools integrated to this environment. Dissert. Abstr.

N91-13107# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Cost Analysis Div.
ECOS USER'S MANUAL AND MENU NAVIGATOR: ITT-HANDLING, DATA ENTRY AND TENDER INTEGRATION
Jan. 1990 291 p
(ESA-PSS-06-101-Issue-1; ISSN-0379-4059; ETN-90-97996)
Copyright Avail: NTIS HC/MF A13

The ESA Costing Software (ECOS) is a personal computer-based program used by ESA contractors for integrated cost proposal preparation. The background of the software development and information relevant to its use is covered. Each major division of ECOS and all relevant screens from the program are reproduced for user reference: ITT (Invitation To Tender) handling, data entry, tender acceptance and integration, and support files. User assistance possibilities are presented, including the new online assistance and electronic data transfer options. The menu navigator and various appendices are provided for quick referencing of help topics, as online help function is not available with the ECOS software. Report options available for presenting ECOS data for meaningful analysis are detailed. ESA

N91-13108*# University of Southern California, Marina del Rey. Information Sciences Inst.
MODEL CHECKING FOR LINEAR TEMPORAL LOGIC: AN EFFICIENT IMPLEMENTATION
Rivi Sherman and Amir Pnueli Jun. 1990 27 p
(Contracts NCC2-539; F30602-88-C-0135; DARPA Order 6131)
(NASA-CR-187644; NAS 1.26:187644; AD-A225189; ISI/RR-89-241) Avail: NTIS HC/MF A03 CSCL 12/2

This report provides evidence to support the claim that model checking for linear temporal logic (LTL) is practically efficient. Two implementations of a linear temporal logic model checker is described. One is based on transforming the model checking problem into a satisfiability problem; the other checks an LTL formula for a finite model by computing the cross-product of the finite state transition graph of the program with a structure

containing all possible models for the property. An experiment was done with a set of mutual exclusion algorithms and tested safety and liveness under fairness for these algorithms. GRA

N91-13109# Naval Postgraduate School, Monterey, CA.
SOLVING THE WEIGHTED REGION LEAST COST PATH PROBLEM USING TRANSPUTERS M.S. Thesis
Ivan Garcia Dec. 1989 72 p
(AD-A225399) Avail: NTIS HC/MF A04 CSCL 12/5

The weighted region least cost path problem involves finding the minimal cost path between a source point and a goal point through a plane that has been subdivided into weighted regions. A new parallel approach is investigated which seeks to take advantage of the distributed, asynchronous computing environment provided by the INMOS Transputer. The algorithm consists of a family of local, asynchronous, iterative and parallel procedures. The program is implemented on a network of transputers using a parallel version of the C programming language and tested on various maps of triangulated weighted regions. Results were favorable in terms of producing a near optimum path and reduced processing time. GRA

N91-13110# Naval Postgraduate School, Monterey, CA.
A PROLOG IMPLEMENTATION OF PATTERN SEARCH TO OPTIMIZE SOFTWARE QUALITY ASSURANCE M.S. Thesis
Raymond Karl Buzzard Mar. 1990 158 p
(AD-A225435) Avail: NTIS HC/MF A08 CSCL 12/5

Quality Assurance (QA) is a critical factor in the development of successful software systems. Through the use of various QA tools, project managers can ensure that a desired level of performance and reliability is built into the system. However, these tools are not without cost. Project managers must weigh all QA costs and benefits for each development environment before establishing an allocation strategy. The development of a system dynamics model has provided project managers with an automated tool that accurately replicates a project's dynamic behavior. This model can be used to determine the optimal quality assurance distribution pattern over a given project's life cycle. The objective of this thesis was to enhance a prototype expert system module that interacts with the system dynamics model for determining QA effort allocation schemes. The new module uses a pattern search algorithm to derive an optimal distribution scheme from a given set of project parameters. This system not only resolves all limitations discovered in the prototype model but also achieved significant reductions in total project cost. GRA

N91-13111# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
SOFT OBJECTS: A PARADIGM FOR OBJECT ORIENTED PROGRAMMING
Ken Haase Mar. 1990 31 p
(Contract N00014-85-K-0124)
(AD-A225513; AI-M-1014) Avail: NTIS HC/MF A03 CSCL 12/4

This paper introduces soft objects, a new paradigm for object oriented programming. This paradigm replaces the traditional notion of object classes with the specification of transforming procedures which transform simpler objects into more complicated objects. These transforming procedures incrementally construct new objects by addition of a new state or providing handlers for new messages. Unlike other incremental approaches (e.g., the inherited exist handlers of Object Logo (Drescher, 1987)), transforming procedures are strict functions which always return new objects; rather than conflating objects and object abstractions (classes), soft objects distinctly separates objects and their abstractions. The composition of these transforming procedures replaces the inheritance schemes of class oriented approaches; order of composition of transforming procedure makes explicit the inheritance indeterminancies introduced by multiple super classes. Issues regarding semantics, efficiency, and security are discussed in the context of several alternative implementation models and the code of a complete implementation is provided in an appendix. GRA

N91-13112# Perceptronics, Inc., Woodland Hills, CA.
RETRIEVAL OF KNOWLEDGE THROUGH ALGORITHMIC DECOMPOSITION Final Report, Apr. 1983 - Sep. 1987
Sarah Lichtenstein Jun. 1990 12 p
(Contract MDA903-83-C-0198)
(AD-A225667; PDRIR-1129-9-87; ARI-RN-90-31) Avail: NTIS HC/MF A03 CSCL 05/8

The report summarizes the results of a series of studies to evaluate the effectiveness of algorithms for estimating unknown quantities. The results of the first experiment show that, as the structure of the aid increases, the subjects' performance improves in terms of both accuracy and consistency across subjects. The second experiment, however, suggests that algorithms used without understanding are of limited help. Further experiments suggest substantial problems in designing decision aids based on algorithmic decomposition, not because the principles of creating algorithms are hard to learn but because the users may be misled by their own misinformation and lack of arithmetic skills. These findings lead us to believe that such decision aids should be used in situations where algorithms can be carefully and deliberately designed and computational aids are also available. Possible approaches are suggested for the design of an expert system using algorithmic decomposition. GRA

N91-13113# Perceptronics, Inc., Woodland Hills, CA.
CREATING ALGORITHMS AS AN AID TO JUDGMENT, PART 2 Interim Report, Apr. 1983 - Sep. 1987
Sarah Lichtenstein and Anna Gilson Weathers Jun. 1990 18 p
(Contract MDA903-83-C-0198)
(AD-A225698; PDRIR-1129-9-87-Pt-2; ARI-RN-90-34-Pt-2) Avail: NTIS HC/MF A03 CSCL 05/8

Previous research has shown that subjects improve their performance in estimating unknown quantities when they are asked to write algorithms about these quantities. These algorithms are short combination rules whereby the subjects decompose the unknown quantities into a series of other quantities that they can more easily estimate and then use these estimates to arrive at an estimate of the requested quantity. This paper extends this research by exploring the effectiveness of asking subjects to work the algorithm they create not once, but twice, first using low estimates for the component parts and again using high estimates for the component parts. This study shows that subjects can be trained to create algorithms, but that the use of algorithms does not improve their performance to any great degree. When successful, the technique of creating an algorithm and using it to make two estimates led to very accurate performance (93 percent correct). But the technique also badly misled subjects on some occasions, bringing down the overall performance. GRA

N91-13114# Princeton Univ., NJ. Cognitive Science Lab.
BATBOOK: AN OUTLINE BOOK AND PROBLEM SOLVING ENVIRONMENT FOR THE STUDY OF SKILL ACQUISITION Interim Report, May 1988 - Oct. 1989
Jeremiah M. Faries and Brian J. Reiser Jul. 1990 32 p
(Contract MDA903-87-C-0652)
(AD-A225699; ARI-RN-90-45) Avail: NTIS HC/MF A03 CSCL 05/8

BATBook is an online book and problem solving environment that facilitates students' use of example in a textbook and use of their own solutions to previous problems. BATBook contains facilities for working on problems and storing solutions and for reading and searching text and examples within the text. All interaction with the system is recorded. BATBook serves as an experimental tool for studies of the use of examples in learning. BATBook has been used for studies of skill acquisition in the programming domain and can be used in similar fashion for other domains such as statistics, mathematics, or physics. GRA

N91-13115# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
A COGNITIVE BASIS FOR A COMPUTER WRITING ENVIRONMENT Interim Report, Oct. 1986 - Oct. 1989
John B. Smith and Marcy Lansman Jun. 1990 38 p

(Contract MDA903-86-C-0345; NSF IRI-85-19517)
(AD-A225734; TR-87-032; ARI-RN-90-52) Avail: NTIS HC/MF A03 CSCL 05/8

This research of cognitive psychologists and composition theorists offers important insights that can guide development of more compatible computer systems. In the sections that follow we first review some of their more important theories and experimental results in order to establish a cognitive basis for a computer writing environment. We then show how those sights influenced key design decisions for a system we are developing. While our system could be used by a variety of writers for many different purposes, it is intended primarily for professionals who write as a part of their jobs. Nevertheless, we believe it illustrates the important relation between cognitive theory and system design and the necessity to consider them together. Our discussion ends with a brief description of our efforts to test both the theoretical basis and the system we have developed in accord with it. GRA

N91-13116# Navy Personnel Research and Development Center, San Diego, CA.
COMPUTER-BASED INSTRUCTION AUTHORING TOOLS SYSTEM (CATS): STUDENT GUIDE Technical Note, Jan. 1989 - Jun. 1990
Vel N. Hulton, Michael R. Flaningam, Barbara Tarker, Ann Rybowiak, Susan Sulzbach, Mark Lyon, and Brian Thomason (Systems Engineering Associates, San Diego, CA.) Jul. 1990 16 p Sponsored by Deputy Chief of Naval Operations, Washington, DC
(AD-A225782; NPRDC-TN-90-29) Avail: NTIS HC/MF A03 CSCL 12/5

This publication is one of three technical notes that supplement the CATS (Computer-Based Instruction Authoring Tools System) user's manual. This guide is intended for students who are taking the computer-based version of the Defense Systems Management College's Funds Management and Tools for Program Management and Tools for Program Management lessons. The objective of this effort was to provide instructions for the use of the disks that the students are given to run each lesson. GRA

N91-13117# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
PHONOLOGICAL RULE INDUCTION: AN ARCHITECTURAL SOLUTION
David S. Touretzky, Gillette Elvgren, III, and Deidre W. Wheeler Jun. 1990 11 p Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678; NSF EET-87-16324)
(AD-A225797; AIP-118; CMU-CS-90-138) Avail: NTIS HC/MF A03 CSCL 05/7

Acquiring phonological rules is hard, especially when they do not describe generalizations that hold for all surface forms. We believe it can be made easier by adopting a more cognitively natural architecture for phonological processing. We briefly review the structure of M3P, our connectionist many maps model of phonology, in which extrinsic rule ordering is virtually eliminated, and iterative processes are handled by a parallel clustering mechanism. We then describe a program for inducing phonological rules from examples. Our examples, drawn from Yawelmani, involve several complex rule interactions. The parallel nature of M3P rule application greatly simplifies the description of these phenomena, and makes a computational model of rule acquisition feasible. GRA

N91-13118# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
PROBLEM-SOLVING TRANSFER AMONG PROGRAMMING LANGUAGES
Quanfeng Wu and John R. Anderson 4 Jun. 1990 45 p Submitted for publication Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678)
(AD-A225798; AIP-134) Avail: NTIS HC/MF A03 CSCL 12/5

Knowledge transfer among three programming languages (LISP, PROLOG, and PASCAL) is investigated. Three experiments were conducted: the first two on transfer between LISP and PROLOG, while the third on transfer between LISP and PASCAL. The results from all the experiments showed evidence of positive transfer; the transfer was positive in terms of time savings from programming in one language to that in another for the same problem. Furthermore, it was found that transfer in programming was largely localized in writing the first drafts of programs. Sometimes this transfer was manifested even though different algorithms were used in programming in different languages for the same problem. To account for the results on transfer across programming languages, a three-level transfer (transfer at the syntactic, algorithmic, and problem levels) theory is proposed. GRA

N91-13119# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE BEHAVIOR LANGUAGE, USER'S GUIDE Memorandum Report
Rodney A. Brooks Apr. 1990 37 p Sponsored in part by Siemens
(Contracts N00014-86-K-0685; N00014-85-K-0124)
(AD-A225808; AI-M-1227) Avail: NTIS HC/MF A03 CSCL 12/5

The Behavior Language is a rule-based real-time parallel robot programming language originally based on ideas from Brooks 86, Connell 89, and Maes 89. It compiles into a modified and extended version of the subsumption architecture Brooks 86 and thus has backends for a number of processors including the Motorola 68000 and 68HC11, the Hitachi 6301, and Common Lisp. Behaviors are groups of rules which are activatable by a number of different schemes. There are no shared data structures across behaviors, but instead all communication is by explicit message passing. All rules are assumed to run in parallel and asynchronously. It includes the earlier notions of inhibition and suppression, along with a number of mechanisms for spreading of activation. GRA

N91-13120# Washington Univ., Seattle. Dept. of Computer Science and Engineering.
A USER-FRIENDLY GRAPHICS TOOLKIT FOR NETWORK MANAGEMENT M.S. Thesis Final Report
James Phillip Hogle 14 Aug. 1990 94 p Sponsored by Army Materiel Command, Alexandria, VA
(AD-A225809) Avail: NTIS HC/MF A05 CSCL 12/5

This thesis describes the Network Graphics Toolkit, which was developed to simplify the creation of graphical network management applications. It was developed using the X11R4 release of the Athena Widget Set and the X Toolkit Intrinsics. It also includes calls to X Library functions when necessary. It was designed to work with a broad range of network management applications and implemented with the graphics code kept distinct from the application's code to improve portability. The toolkit's features and limitations are described in detail. The thesis also evaluates a number of graphical programs, assessing the appropriate capabilities for a graphics toolkit. Finally it discusses the suitability of the Athena Widgets for large graphical applications, and related applications that have implemented the toolkit. GRA

N91-13121# Naval Postgraduate School, Monterey, CA.
AFFINE INVARIANT MATCHING OF NOISY OBJECTS M.S. Thesis
Chang-Lung Kao Dec. 1989 99 p
(AD-A225839) Avail: NTIS HC/MF A05 CSCL 12/9

In computer vision many techniques have been developed for object recognition. The affine invariant matching algorithm proposed by Hummel and Wolfson (1988) is a new and interesting method. Under affine transformation, objects with translation, rotation, scale changes, and/or even partial occlusion will have the same or similar coefficients. However, some serious problems exist in the original algorithm. This thesis begins with the discussion of the affine transformation. The shortcomings that can occur in this method such as the basis instability, the collision of hash table, and the noise sensitivity will be discussed. Among them the noise sensitivity is a serious problem. This can always cause the

recognition procedure to fail. In this thesis an improved affine invariant matching algorithm was developed to overcome the noise problem and other disadvantages of the original algorithm. The area test criteria were adopted to avoid the numerical instability problem. The modified hashing structure using a special hash function was implemented to achieve faster accessing and voting. In the recognition procedure, the partial voting technique with the consideration of false peaks from the voting array highly enhanced the noise tolerance of the algorithm. Finally, the results obtained from the improved algorithm clearly showed better performance than those of the original algorithm. GRA

N91-13122# Naval Postgraduate School, Monterey, CA.
TRUNCATED SUM MVL MINIMIZATION USING THE NEIGHBORHOOD DECOUPLING ALGORITHM M.S. Thesis
Yao-Ming Wang Dec. 1989 65 p
(AD-A225916) Avail: NTIS HC/MF A04 CSCL 12/4

Several heuristics have been developed for the multiple-valued logic minimization problem, and while each claims some advantages in specific examples, none is significantly better than the others. Heuristic methods are interesting because exact minimization methods are extremely time-consuming. With the computer software developed at NPS called HAMLET, users can easily investigate their own heuristics. The primary goal of this thesis is to develop an algorithm that makes the minimization of multiple-valued logic functions reasonably close to the optimal solution. The neighborhood decoupling (ND) algorithm is built on top of HAMLET. The idea of the ND algorithm is to always select the most isolated minterm as well as choose the most isolated implicant. In this thesis, the implementation of the ND algorithm is described. A performance analysis of the ND algorithm is presented by comparing results and computation time with two published algorithms, Pomper and Armstrong's and Dueck and Miller's. GRA

N91-13123# Mitre Corp., Bedford, MA.
THE AMPS Final Technical Report, Oct. 1985 - Sep. 1989
Bruce Dawson, David S. Day, and Alice Mulvehill Jul. 1990 102 p
(Contract F19628-89-C-0001)
(AD-A225988; RADC-TR-90-131) Avail: NTIS HC/MF A06 CSCL 12/9

This major product of the automatic manufacturing programming system (AMPS) project is the CAMPS System, the purpose of which is to provide a domain-independent base on which to construct application-specific planning systems. The target applications for which CAMPS-based systems are not most applicable are characterized by problems that are highly constrained, and that involve the scheduling of tasks and the allocation of resources. CAMPS is the outgrowth of a number of distinct strands in artificial intelligence research, but the core problem solving approach is that of constraint-satisfaction search. The CAMPS collection of tools and predefined domain-independent knowledge structures are used to construct a description of a problem in terms of variables and constraints. The planning process carried out by CAMPS consists of finding a set of values for each of these variables that satisfies all of the constraints imposed by the domain. Two application systems were built using CAMPS: AMPS and EMPRESS-II. GRA

N91-13124# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
MULTIVALUED POSSIBILITIES MAPPINGS
Nancy A. Lynch Aug. 1990 35 p
(Contracts N00014-85-K-0168; N00014-83-K-0125)
(AD-A226110; MIT/LCS/TM-422) Avail: NTIS HC/MF A03 CSCL 12/5

Abstraction mappings are one of the major tools used to construct correctness proofs for concurrent algorithms. Several examples are given of situations in which it is useful to allow the abstraction mappings to be multivalued. The examples involve algorithm optimization, algorithm distribution, and proofs of time bounds. Abstraction mappings are one of the major tools that the author and colleagues use to construct correctness proofs for concurrent (including distributed) algorithms. In this paper, she tries to make one major point about such mappings: that it is useful to allow them to be multivalued. That is, often when one maps a low-level algorithm L to a high-level algorithm H, one would like to allow several states of H to correspond to a single state of L. I believe that any useful framework for describing abstraction mappings should include the ability to describe multivalued mappings. GRA

N91-13125# Wright Research Development Center, Wright-Patterson AFB, OH.
I3G VIRGO: INTERACTIVE GRAPHICS FOR GEOMETRY GENERATION AND VISUAL INTERACTIVE RAPID GRID GENERATION. USER'S MANUAL
Howard T. Emsley May 1990 76 p
(AD-A226117; WRDC-TM-90-317) Avail: NTIS HC/MF A05 CSCL 12/5

I3G/VIRGO uses interactive computer graphics to display the geometric model as it is being manipulated or built. The user views, picks, and manipulates geometries via mouse and keyboard inputs and is provided the flexibility to generate both the surface and field grids of complex configurations. Because the user visually sees what is being generated, errors are easier to detect, and fewer are made. Discussions were held with experienced analysis code users prior to the design of I3G and VIRGO, and continual inputs during development have assured an optimal human interface. The operation of I3G/VIRGO is intimately tied to its use of menu selecting and prompting to allow both the experienced and uninitiated user to input information easily. The program also contains an on-line help capability that can be requested by the user at any point during program operation. GRA

N91-13126# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
CENTRAL-SERVER-BASED ORPHAN DETECTION FOR ARGUS M.S. Thesis
Steven C. Markowitz May 1990 150 p
(Contracts N00014-83-K-0125; N00014-89-J-1988)
(AD-A226133; MIT/LCS/TR-485) Avail: NTIS HC/MF A07 CSCL 12/7

One problem that can arise in a distributed computer system is that of orphans. These are computations that continue to execute even though their results are no longer needed. They can arise as a result of aborted transactions or node crashes. Orphans are bad because they waste resources and can cause a program to behave unpredictably. The Argus system makes use of an algorithm to detect and destroy orphans before they can cause harm. This scheme does not delay normal computations and avoids unnecessary communication between nodes. This is accomplished by piggybacking orphan detection information on normal system messages. The current version of this algorithm is impractical because of the large amount of information that must be included in all messages between nodes. GRA

N91-13127# Naval Postgraduate School, Monterey, CA.
EXTENDING THE SYSTEM DYNAMICS MODEL OF SOFTWARE PROJECT MANAGEMENT TO A MULTIPROJECT ENVIRONMENT M.S. Thesis
Darlene A. Brabant Mar. 1990 141 p
(AD-A226163) Avail: NTIS HC/MF A07 CSCL 12/5

Increase in the demand for software, coupled with concerns regarding cost overruns, and schedule delays in software development lead experts to believe that the United States will be unable to produce the software it needs. In order to improve their performance, software professionals must first understand the development process. The system dynamics model of software project management provided a tool for the understanding of a single project. This tool was expanded to model a multiproject environment in which more than one project is managed. Identification and addition of the variables necessary to reflect manpower decisions resulting in-movement between projects and

within an organization were effected. This enhancement provided insights onto the allocation of resources to projects and into the optimization of the staffing function. GRA

N91-13128# Stanford Univ., CA. Information Systems Lab.
ALGORITHMS AND ARCHITECTURES FOR HIGH SPEED SIGNAL PROCESSING Final Report, 1 Apr. 1987 - 31 Mar. 1990
Thomas Kailath 1990 33 p
(Contract DAAL03-87-K-0033)
(AD-A226203; ARO-24954.33-MA-SDI) Avail: NTIS HC/MF A03 CSCL 12/1

Studies of systematic design procedures for a class of structured algorithms often encountered in signal processing applications are discussed. These are being called Regular Iterative Algorithms (RIAs). These ideas have been successfully used by a former student who helped to develop this theory, Dr. S. K. Rao of AT and T Bell Laboratories in Holmdel, N.J. Dr. Rao has found the RIA results helpful in designing several fast integrated circuit chips for communications and signal processing applications, some of which are being used in the AT and T - ZENITH joint effort on High Definition Television (HDTV). The other set of results deals with the issue of designing configurable and fault tolerant processor arrays such that if some of the processors in the given array are faulty, then a fault free array can be constructed comprising only the healthy processors. Such studies can be easily motivated in the case of Wafer Scale Integration (WSI) technology where for example, a large number of processors, configured in the form of a grid, can be put on a single wafer. Due to yield problems, some of the processors are invariably going to be faulty. In such a case, instead of treating the whole wafer as defective, one can work around the faulty processors and reconfigure the rest in the form of a grid. GRA

N91-13129# Perceptronics, Inc., Woodland Hills, CA.
ARITHMETIC SKILLS IN USING ALGORITHMS Interim Report, Apr. 1983 - Aug. 1987
Sarah Lichtenstein and Donald MacGregor Jun. 1990 20 p
(Contract MDA903-83-C-0198)
(AD-A226272; PDRIR-1129-8-87; ARI-RN-90-30) Avail: NTIS HC/MF A03 CSCL 12/1

An algorithm is a series of steps or operations that, when sequentially applied, produces a solution to a problem. Properly applied, algorithms are helpful when a complex or difficult numerical question can be broken into subquestions. This paper identifies and details a serious barrier to the effective use of algorithms: weak mathematical skills. Given an algorithm of 13 steps requiring copying, converting from percentages to proportions, adding, subtracting, multiplying, and dividing, 78 percent of our subjects made one or more errors in the task. These results suggest that decision aids be tested on the population for which they were intended, to avoid problems arising from unexpected deficits in users' knowledge and skills. GRA

N91-13130# Virginia Univ., Charlottesville. Dept. of Computer Science.
SEVENTH IEEE WORKSHOP ON REAL-TIME OPERATING SYSTEMS AND SOFTWARE Final Report, 1 Jan. - 31 Dec. 1990
Robert P. Cook Sep. 1990 168 p Workshop held in Charlottesville, VA, 10-11 May 1990
(Contract N00014-90-J-1339)
(AD-A226320; UVA/525442/CS91/101) Avail: NTIS HC/MF A08 CSCL 12/5

Some topics of discussion at the workshop were as follows: Operating Systems Support for Adaptable Real Time Systems; Chaos(arc): A Kernel for Predictable Programs in Dynamic; Implementing a Predictable Real Time Multiprocessor Kernel; UNIX Rewritten for Real time; Research in Time-and Error-Constrained Database Query Processing; Scheduling Real Time Transactions in Distributed Database System; Preemption vs. Priority, and the Importance of Early Blocking; Supporting Real Time Concurrency; RTL Meets ORE; Complier Assisted Adaptive Scheduling in Real Time Systems; Developing Software with Predictable Timing Behavior; A Synthetic Workload for Real time Systems; Real Time Mentat Programming Language and Architecture; A von Neumann/Dataflow Hybrid Approach to Real Time Computing; Fault Tolerance Approaches in Two Experimental Real Time Systems; Resource Management for Digital Audio and Video; Timing Analysis of a Robot Motion Planning Algorithm; and Software Development for Hard Real Time Systems. GRA

N91-13131# Naval Civil Engineering Lab., Port Hueneme, CA.
AUTOMATED DYNAMIC RELAXATION SOLUTION ALGORITHMS FOR COMPLIANT SYSTEMS Final Report, 1987 - 1989
T. A. Shugar May 1990 51 p Sponsored by Office of Navy Technology, Arlington, VA
(AD-A226383; NCEL-N-1812) Avail: NTIS HC/MF A04 CSCL 13/13

Tensioned or compliant structures, such as fabric shelter systems and ocean cable systems, are composed of very flexible structural components that exhibit a high degree of geometrical nonlinearity and analytical complexity. Structural analysis of these systems is a two-phase procedure: (1) the determination of the static equilibrium configuration or prestressed state of the structure; and (2) the determination of structural response relative to the equilibrium configuration due to static and dynamic in-service loads. Static solution algorithms are addressed for reliable phase-one solution procedures. In contrast to the standard Newton-Raphson (NR) incremental/iterative algorithm, the automated dynamic relaxation (ADR) solution algorithm is a pure iterative algorithm and it is also simple to implement. The ADR algorithm's performance is globally convergent in test problems having multiple solutions, whereas NR algorithms are known to be only locally convergent. The ADR algorithm can be successfully utilized to form the basis of structural analysis software for specialized, highly nonlinear problems involving tensioned structures. GRA

N91-13132# Lawrence Livermore National Lab., CA.
APTBLIBE: GEOMETRICAL AND MONTE CARLO SAMPLING ROUTINES FOR THE CRAY COMPUTER
Arthur L. Edwards Apr. 1990 130 p
(Contract W-7405-eng-48)
(DE91-000498; UCRL-ID-103432) Avail: NTIS HC/MF A07

APTBLIBE is a new BUILD library of about 151 Cray-compiled binary subroutines for numerical geometry and Monte Carlo sampling, of which 93 are described here (the rest will be described in a revision). It is designed especially to support 2-D and 3-D codes that generate and track beams or particles of energy or matter (APT = All-Particle-Tracking). The LIB library APTBLIBE contains the FORTRAN source files, and the user document APTDOC, much of which can be updated directly from the source files. This document describes APTBLIBE and its subroutines, how to use them, and the features designed to simplify the development of new codes, and improve the speed, efficiency, reliability and ease of maintenance of any codes which make use of it. DOE

N91-13133# Lawrence Livermore National Lab., CA. Computer Research Group.
AN INFORMATION-THEORETIC LOOK AT BRANCH-PREDICTION
Carl G. Ponder and Michael C. Shebanow (Motorola, Inc., Austin, TX.) 11 Sep. 1990 32 p Submitted for publication
(Contract W-7405-eng-48)
(DE91-000499; UCRL-ID-106077) Avail: NTIS HC/MF A03

Accurate branch-prediction is necessary to utilize deeply pipelined and very long instruction-word (VLIW) architectures. For a set of program traces we show the upper limits on branch predictability, and hence machine utilization, for important classes of branch-predictors using static (compiletime) and dynamic (runtime) program information. A set of optimal superpredictors is derived from these program traces. These optimal predictors compare favorably with other proposed methods of branch-prediction. DOE

N91-13134# Oak Ridge National Lab., TN.
SQTTEXT: A TOOL FOR EDITING STRUCTURED QUERY LANGUAGE (SQL) TEXT WITHIN ORACLE SQL*FORMS APPLICATIONS
Patricia F. Daugherty and Paul T. Singley Aug. 1990 36 p
(Contract DE-AC05-84OR-21400)
(DE91-000534; ORNL/TM-11639) Avail: NTIS HC/MF A03

SQTTEXT is an ORACLE SQL*Forms application that allows a programmer to view and edit all the Structured Query Language (SQL) text for a given application on one screen. This application is an outgrowth of the prototyping of an on-line system dictionary for the Worldwide Household Goods Information System for Transportation-Modernization decision support system being prototyped by the Oak Ridge National Laboratory, but it can be applied to all SQL*Forms software development, debugging, and maintenance. The system dictionary and SQTTEXT were written in version 2.3 of ORACLE's application generator, SQL*Forms. SQL*Forms greatly simplifies users' access to ORACLE databases, but the design of the tool should be friendlier to those programming, debugging, and maintaining SQL*Forms applications. Because SQL*Forms version 2.3 forces the programmer to view each component of a program through a window specific to that component, it is impossible to get an overview of the whole application at one time. The SQTTEXT application allows experienced ORACLE programmers to increase their productivity by allowing access to all Structured Query Language (SQL) text within a SQL*Forms application via one screen. The SQTTEXT application is based on the eight ORACLE Integrated Application Processor (IAP) tables that store information about SQL*Forms applications. The SQTTEXT application displays the trigger level, trigger name, and SQL text associated with triggers, and also displays block names, base table names, and the SQL text for WHERE/ORDER BY clauses. This report provides a step-by-step explanation of how to use SQTTEXT, descriptions of the IAP tables, and a listing of the SQTTEXT code. DOE

N91-13135# Stanford Univ., CA. Systems Optimization Lab.
MODIFYING MINOS FOR SOLVING THE DUAL OF A LINEAR PROGRAM
Eithan Schweitzer Aug. 1990 52 p
(Contracts N00014-89-J-1659; DE-FG03-87ER-25028; NSF DMS-89-13089; NSF ECS-89-06260; EPRI Proj. RP-8010-09)
(AD-A226449; SU-SOL-90-11) Avail: NTIS HC/MF A04 CSCL 12/5

In many situations it is advantageous to solve the dual of a linear program rather than the primal. For example, an approach to solve two stage stochastic linear programs with recourse employs Bender's decomposition (Dantzig and Glynn 1990). Within this algorithm, cuts (necessary conditions for the second stage costs) are added sequentially to the master problem. In the primal version of the master problem, cuts appear as new rows. In each iteration of Bender's decomposition algorithm, when a new row is added, the previous solution of the master problem gets infeasible. However, when solving the dual of the master problem, a cut appears as a column. When adding a new column, the previous solution of the master problem remains feasible and the new optimal solution can be obtained within a few simplex iterations. This report describes the changes made by the author in the MINOS file MI35INPT, so MINOS could transform the given primal linear program, specified in an MPS file, to its dual, solve the dual and in addition, write another MPS file which contains the specification of the dual problem. GRA

N91-13136# Naval Ocean Systems Center, San Diego, CA.
FRACTAL-BASED IMAGE COMPRESSION, 2 Interim Report
E. W. Jacobs, R. D. Boss, and Y. Fisher Jun. 1990 23 p
Sponsored by ONR, Arlington, VA
(AD-A226500; NOSC/TR-1362) Avail: NTIS HC/MF A03
CSCL 12/9

This technical report comprises a short review of the theory of Iterated Function Systems (IFSs), and a discussion of Recurrent Iterated Function Systems (RIFSs) - an extension of IFS codes which allows for encoding of a far wider set of digital images. The method and a demonstration of a RIFS-based scheme for automatic compression of images composed of contours is also presented. Finally, a short discussion and a few examples of how these concepts can be used to automatically compress grey scale images is given. GRA

N91-13137# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
THE CLASSIFICATION AND EVALUATION OF COMPUTER-AIDED SOFTWARE ENGINEERING TOOLS M.S. Thesis
Gary W. Manley Sep. 1990 197 p
(AD-A226613) Avail: NTIS HC/MF A09 CSCL 12/5

The use of Computer-Aided Software Engineering (CASE) tools has been viewed as a remedy for the software development crisis by achieving improved productivity and system quality via the automation of all or part of the software engineering process. The proliferation and tremendous variety of tools available have stretched the understanding of experienced practitioners and has had a profound impact on the software engineering process itself. To understand what a tool does and compare it to similar tools is a formidable task given the existing diversity of functionality. This thesis investigates what tools are available, proposes a general classification scheme to assist those investigating tools to decide where a tool falls within the software engineering process and identifies a tool's capabilities and limitations. This thesis also provides guidance for the evaluation of a tool and evaluates three commercially available tools. GRA

N91-13138# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
FAST LEFT-LINEAR SEMI-UNIFICATION
Fritz Henglein 22 Dec. 1989 22 p
(RUU-CS-89-33; ETN-90-98123) Avail: NTIS HC/MF A03

A result that proves that Left Linear Semi Unification (LLSU) is decidable by giving an exponential time decision procedure is improved upon. A generic polynomial time algorithm L1 for LLSU, which shows that LLSU is in P, is presented. It is shown that L can be implemented in time O(n to the 3rd power) by using a fast dynamic transitive closure algorithm. LLSU is proved P-complete under log-space reductions, thus giving evidence that there are no fast (NC-class) parallel algorithms for LLSU. As a corollary of the proof of P-completeness, it is shown that LLSU with only 2 term inequalities is already P-complete. It is conjectured that L1 can be implemented in time O(n to the 2nd power), which is the best that is possible for the solution method described by L. The basic question as to whether another solution method may admit even faster algorithms is open. It is conjectured that LLSU with 1 inequality is also P-complete. ESA

N91-13139# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
PROPERTIES OF MODELS WHICH ARE COMPLETE FOR HOARE LOGIC
R. Hoofman Jan. 1990 12 p
(RUU-CS-90-1; ETN-90-98124) Avail: NTIS HC/MF A03

A model M is said to be complete for Hoare logic if sound and complete with respect to M. A model is said to be expressive if for each program alpha and each formula phi the weakest precondition omega p(alpha,phi) is definable, i.e., there is a formula psi which has omega p(alpha,phi) as interpretation. It is known that all expressive models are complete, and that complete models exist which are not expressive. It is shown that all complete models have a property which comes very close to expressivity: with respect to any complete model M, there always is a definable set between the total weakest precondition and the weakest precondition. This property is called weak expressivity. Among other things it follows that the weakest preconditions of total programs are always definable in a complete model. ESA

N91-13140# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
ALGORITHMS FROM THEOREMS

Johan Jeuring Jan. 1990 22 p Presented at ICIF TC2/WG2.2/WG2.3 Working Conference on Programming Concepts and Methods, Sea of Gallilee, Israel, 2-5 Apr. 1990 Submitted for publication Sponsored by Netherlands Organization for Scientific Research
(RUU-CS-90-3; ETN-90-98125) Avail: NTIS HC/MF A03

The derivations of algorithms from their specification in the Bird-Meertens formalism is demonstrated. The Bird-Meertens formalism is a programming methodology which provides a concise functional notation for algorithms and for proving equalities of functions. High level specifications (which usually are clearly correct, but inefficient functional algorithms) are transformed, using the promotion theorem, into efficient algorithms. The method is applied to problems on permutations (such as sorting), subsequencies and partitions. For each of these enumerator functions one theorem is proved which is used in the derivation of algorithms for some concrete examples. ESA

N91-13141# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
TOOLS FOR THE RECTILINEAR STEINER TREE PROBLEM
C. M. Jonker and V. C. J. Disselkoen 4 Apr. 1990 56 p
(RUU-CS-90-8; ETN-90-98127) Avail: NTIS HC/MF A04

A Rectilinear Minimal Steiner Tree (RMST) for a set V of n points is a tree which connects the points of V using line segments parallel to the horizontal and vertical coordinate axes that has the shortest possible total length. Techniques are presented identifying connections that will be used in some RMST. These connections serve as a basis for an approximation algorithm. The identification methods are called contraction and clustering. Contractions identify line segments connected to the points on the enclosing rectangle of V and are totally independent of the further construction of the RMST. Clusturing identifies connections that can also be internal to the enclosing rectangle, but which are subject to restrictions posed by the further construction of the RMST. The approximation yields minimal Steiner trees for any set V of n less than or equal to 5 points, and trees with a length that is strictly less than 3/2 times the length of the RMST for larger n. The complexity of the constructing algorithms is O(n squared). ESA

N91-13142# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
MINIMUM HOP ROUTE MAINTENANCE IN STATIC AND DYNAMIC NETWORKS
Anneke A. Schoone Apr. 1990 40 p Sponsored by EEC
(RUU-CS-90-18; ETN-90-98131) Avail: NTIS HC/MF A03

Distributed algorithms for computing minimum hop distances in a network are discussed from a general point of view and are applied to minimum hop routing. It is shown how different models of computation lead to different algorithms known from the literature. The effect of various network assumptions (static, dynamic) upon minimum hop route maintenance are discussed. Using the Krogdahl-Knuth technique of system-wide invariants, the following distributed algorithms are proved correct: the minimum hop route determination algorithms of Gallager and Friedman for static networks and the route maintenance algorithm of Chu for dynamic networks. ESA

N91-13143# Technische Univ., Berlin (Germany, F.R.). Fachbereich fuer Verkehrswesen.
CONSTRUCTING OF FAST VISUALIZATION METHODS FOR GRAPHICALLY DESIGN PROCESSES Ph.D. Thesis [DER EINSATZ SCHNELLER VISUALISIERUNGSMETHODEN FUER DEN GRAFISCH-INTERAKTIVEN ENTWURFSPROZESS]
Gert-Andreas Meissner 1990 199 p In GERMAN; ENGLISH summary
(ETN-90-98179) Avail: NTIS HC/MF A09

The status of the pertinent software and hardware techniques is reviewed. A systematic process is developed for selecting alternative graphical representation primitives and attributes for depicting physical or engineering relevant calculation or measurement results. The associated data interface was described by involving scalar, vectorial and tensorial data correlated to line, surface, or volume oriented geometries. The obtained results were treated by an object oriented graphical interactive design system in which the user interface is specially important for the acceptance of the system and which is conceived on the basis of an open system architecture. Fast picture generation and updating were achieved by relying on advanced interaction methods. ESA

N91-13144# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
ITERATION PROCESSES FOR THE RESOLUTION OF LINEAR SYMMETRIC COMPLEMENTARY PROBLEMS AND THEIR UTILIZATION FOR QUADRATIC PROGRAMS Ph.D. Thesis [UEBER ITERATIONSVERFAHREN ZUR LOESUNG LINEARER SYMMETRISCHER KOMPLEMENTARITAETSPROBLEME UND IHRE ANWEDUNG AUF QUADRATISCHE PROGRAMMAE]
Walter Lohf 1990 88 p In GERMAN
(ETN-90-98183) Avail: NTIS HC/MF A05

The perturbated function epsilon(f) + g where f and g are convex functions and epsilon is a positive real parameter is studied. If g is linear, a quadratic program is built, which is equivalent to a linear symmetric complementary problem. It is shown that iteration processes of gradient projection type with a positive semidefined matrix converge even if the slater condition is not satisfied. The choice of the parameter epsilon is realized in case of linear programs by a positive null-series so that the series converges to the optimal solutions of the perturbated program. ESA

N91-13145# Grenoble-1 Univ. (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
ADAPTIVE AND COMPARATIVE STUDY OF THE MAIN VARIATIONS OF KARMARKAR'S ALGORITHM Ph.D. Thesis [ETUDE ADAPTATIVE ET COMPARATIVE DES PRINCIPALES VARIANTES DANS L'ALGORITHME DE KARMARKAR]
Abdelkrim Keraghel 1989 114 p In FRENCH
(ETN-90-98198) Avail: NTIS HC/MF A06

The Karmarkar method is described. The value of the displacement step proposed by Karmarkar is improved upon. The practical difficulties involved in this improvement are outlined. Various extensions and variations of the method are studied. A unification approach to be used on the most significant variations is presented. The performance of this approach is analyzed. Numeric experimentation obtained using the different variants and their comparison with simplified methods and approaches used in the Karmarkar method is presented. ESA

N91-13146# Institut National Polytechnique, Grenoble (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
CONTRIBUTION TO THE STUDY OF AUTOMATIC ROUNDED ERROR CONTROL: THE SCALP METHOD Ph.D. Thesis [CONTRIBUTION A L'ETUDE DE METHODES DE CONTROLE AUTOMATIQUE DE L'ERREUR D'ARRONDI: LA METHODOLOGIE SCALP]
Philippe Francois 1989 141 p In FRENCH
(ETN-90-98206) Avail: NTIS HC/MF A07

The various methods of rounded error control are summarized. The foundations of the probabilistic models used in error evaluation are given particular attention. The SCALP methodology for carrying out qualitative arithmetic analysis of software is outlined. The new theoretical indicators of arithmetic quality are defined. A software method of evaluating such indicators is presented. The need to carry out further research in the area of arithmetic stability is stressed. Other analysis frameworks used in the study of perturbation resistance could be used as a basis for further study. ESA

N91-12540# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
A GRID GENERATION ON BODY SURFACE USING MASTER DIMENSION SYSTEM
Hiroshi Wakai *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 171-176 In

JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12542# Institute of Computational Fluid Dynamics, Tokyo (Japan).
STRUCTURED GRID GENERATION BASED ON UNSTRUCTURE GRID
Masahiro Suzuki *In* NAL, Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 185-187 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12543# National Aerospace Lab., Tokyo (Japan).
A NEW ALGORITHM FOR GENERATING BLOCK-STRUCTURED GRID AND ITS APPLICATION TO COMPLEX AIRCRAFT CONFIGURATIONS
Susumu Takanshi and Motomu Sato (Meitec Ltd., Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 189-193 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12545# National Aerospace Lab., Tokyo (Japan).
GENERATION OF 3-D GRID USING BOUNDARY ELEMENT METHOD
Mitsunori Yanagizawa, Masaaki Nakadate, Yasuhiro Koshioka, and Atushi Inoue (Fuji Heavy Industries Ltd., Utsunomiya, Japan) *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 201-207 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12547# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF THE KNUDSEN LAYER DYNAMICS USING THE DIRECT SIMULATION MONTE CARLO METHOD
Sadamu Saito (Nippon Electric Co. Ltd., Tokyo, Japan) and Katsuhisa Koura *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 215-220 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12564# Ebasco Services, Inc., Lyndhurst, NJ. Corporate Quality Programs Div.
SOFTWARE SUPPLIER EVALUATION AND ASSESSMENT
R. Kosinski and J. M. Gushue *In* AIAA, Proceedings of the 1990 AIAA/FAA Joint Symposium on General Aviation Systems May 1990 p 2-15 (For primary document see N91-12563 04-01)
Avail: NTIS HC/MF A17

N91-12599# National Aerospace Lab., Tokyo (Japan).
SIMULATIONS FOR A PARALLEL COMPUTER
Koichi Harada *In its* Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 49-54 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

N91-12697# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes at de Recherches en Informatique.
FORMALIZING DEVELOPMENTS: FROM THEORY TO PRACTICE
Karim Bechane and Michel Lemoine *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 9 p (For primary document see N91-12682 04-08)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-12699# Royal Signals and Radar Establishment, Malvern (England).
FAULT TOLERANCE VIA FAULT AVOIDANCE
B. D. Bramson *In* AGARD, Fault Tolerant Design Concepts for Highly Integrated Flight Critical Guidance and Control Systems Apr. 1990 10 p (For primary document see N91-12682 04-08)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-13319*# Elizabeth City State Univ., NC. Dept. of Mathematics and Computer Science.
A THREE-DIMENSIONAL APPLICATION WITH THE NUMERICAL GRID GENERATION CODE: EAGLE (UTILIZING AN EXTERNALLY GENERATED SURFACE)
Johnny L. Houston *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 60-61 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 09B

N91-13326*# Elizabeth City State Univ., NC. Dept. of Technology.
A USER-FRIENDLY MENU-DRIVEN LANGUAGE-FREE LASER CHARACTERISTICS CURVES GRAPHING PROGRAM
Glenn Klutz *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 75-76 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 09B

N91-13332*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
PARALLEL-VECTOR COMPUTATION FOR CSI-DESIGN CODE Abstract Only
Duc T. Nguyen *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 90 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 09B

N91-13343*# Northeastern Univ., Boston, MA. Dept. of Computer Systems Engineering.
IMPROVING SYSTEM RELIABILITY THROUGH FORMAL ANALYSIS AND USE OF CHECKS IN SOFTWARE
Mark E. Staknis *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 115-116 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N91-13147*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
AdaNET RESEARCH PLAN
John G. McBride (Softech, Inc., Houston, TX.) 1 May 1990 66 p
(Contract NCC9-16)
(NASA-CR-187262; NAS 1.26:187262) Avail: NTIS HC/MF A04 CSCL 09B

The mission of the AdaNET research effort is to determine how to increase the availability of reusable Ada components and associated software engineering technology to both private and Federal sectors. The effort is structured to define the requirements for transfer of Federally developed software technology, study feasible approaches to meeting the requirements, and to gain experience in applying various technologies and practices. The overall approach to the development of the AdaNET System Specification is presented. A work breakdown structure is presented

with each research activity described in detail. The deliverables for each work area are summarized. The overall organization and responsibilities for each research area are described. The schedule and necessary resources are presented for each research activity. The estimated cost is summarized for each activity. The project plan is fully described in the Super Project Expert data file contained on the floppy disk attached to the back cover of this plan.
Author

N91-13148# Colorado Univ., Boulder.
THEORIES, METHODS, AND TOOLS FOR THE DESIGN OF USER-CENTERED COMPUTER SYSTEMS Interim Report, Sep. 1986 - Feb. 1989
Gerhard Fischer and Walter Kintsch Jul. 1990 42 p
(Contract MDA903-86-C-0143)
(AD-A225700; ARI-RN-90-47) Avail: NTIS HC/MF A03 CSCL 12/7

There are many aspects to the term user-centered. For this research, we have concentrated on the issue of information management. Our theoretical starting point was to identify the distinction between two levels of mental representations that users have of the tasks they want to perform on computer systems. In our proposal to ARI, we planned to distinguish between a situation model and a system model. The situation model is a representation of the task the user wants to perform in terms of the specific task domain. It is subjective and varies somewhat among individuals, but our assumption has been that it is well specified. In order to do anything, however, the user's situation model must be transformed into a system model, which is normative and system specific. This distinction has been the driving idea behind the theorizing and system building in this project. Our question has been, how, for a variety of tasks in which information management plays a central role, this transformation is achieved, and what system support can be provided for it. GRA

N91-13149# Cornell Univ., Ithaca, NY.
FELLOWSHIP IN PARALLEL AND DISTRIBUTED COMPUTING Final Report, 1 Jun. 1986 - 31 May 1990
Anil Nerode Jul. 1990 6 p
(Contract DAAL03-86-G-0021)
(AD-A225926; ARO-23771.1-MA-F) Avail: NTIS HC/MF A02 CSCL 12/9

This grant has been used to support several graduate students and researchers in the area of modeling and simulation. The final report lists these individuals and summarizes their research. These reports include a discussion of the following: on moving and orienting objects; integration constraints in parametric design of physical objects; dynamic bounding of robotic systems; a solid modeling system; unconstrained robot motion; a highly robust finite precision algorithm for the intersection of curved (quadric) solids; and the synthesis of a computer based design, analysis, and simulation environment. GRA

N91-13150# Naval Postgraduate School, Monterey, CA.
ANALYSIS OF END-TO-END PERFORMANCE OF LAN SYSTEMS M.S. Thesis
Chih-Lun Chou Mar. 1990 150 p
(AD-A226161) Avail: NTIS HC/MF A07 CSCL 25/5

The analysis of LAN performance is the main objective of this research. LANs can be configured in various ways combining different medium access control mechanisms and different physical layer specifications. Details on these alternatives are specified in IEEE 802.3 through IEEE 802.5. We study the performance of different types of LANs under various configurations of servers and stations. The queueing network model is one of the analytical tools to help investigate the performance characteristics of various LAN configurations. Since the analytical approach based on queueing network models is often too complicated to be practically used, we rely on simulations. Thus our analysis will be based on simulations, and SIMLAN II will be the simulation tool for our work. Our specification of simulation models involves three classes of transactions, and one or two servers. There are 24 simulation results in this thesis. These results, which are arranged in tables and figures, help compare the performance characteristics of various LAN configurations. GRA

N91-13151# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
PROGRAMMING THE DATA STRUCTURE ACCELERATOR
Richard Zippel 1990 11 p
(Contracts N00014-88-K-0591; N00014-89-J-1946; NSF DMC-86-17355)
(AD-A226334) Avail: NTIS HC/MF A03 CSCL 12/5

We present a fine grained, massively parallel single instruction multiple data (SIMD) architecture, called the data structure accelerator, and demonstrate its use in a number of problems in computational geometry. This architecture is extremely dense and highly scalable. Systems of 10 to the 6th power processing elements can be feasibly embedded in workstations. We advocate that this architecture be used in tandem with conventional, single sequence machines and with small scale, shared memory multiprocessors. A language for programming such heterogeneous systems is presented that smoothly incorporates the SIMD instructions of the data structure accelerator with conventional single sequence code. Author (GRA)

N91-13152# Virginia Univ., Charlottesville. Dept. of Computer Science.
A HIGH PERFORMANCE COMPUTER ARCHITECTURE FOR EMBEDDED AND/OR MULTI-COMPUTER APPLICATIONS Final Report
William A. Wulf and Anita K. Jones Sep. 1990 10 p
(Contract N00014-89-J-1699)
(AD-A226478; UVA/525435/cs91/101) Avail: NTIS HC/MF A02 CSCL 12/6

Under a grant the authors have produced a set of studies, simulations, software, performance data, documents and designs. These are the result of refining the architectural definition of the WM machine, implementing a portion of it, and analyzing various aspects of it when realized in a high performance implementation. GRA

N91-13153# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
SCHEDULING JOBS ON PARALLEL MACHINES, EACH WITH A UNIT-CAPACITY BUFFER
S. M. Baas, W. Kern, and Wim M. Nawijn Dec. 1989 17 p
(MEMO-837; ISSN-0169-2690; ETN-90-98098) Avail: NTIS HC/MF A03

A set of k parallel machines and a set of n jobs which arrive at fixed times is given. Each job has a fixed, but machine dependent processing time and value. Each machine can process one job at a time. A job is processed either immediately after its time of arrival or after having spent some time in a buffer, or it is rejected. It is shown that under certain weak conditions the problem of finding a minimum weight schedule can be solved in polynomial time, but that it becomes NP-complete if such conditions do not hold. ESA

N91-13154# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
PREFIX ROUTING SCHEMES IN DYNAMIC NETWORKS
Erwin M. Bakker, Jan vanLeeuwen, and Richard B. Tan Mar. 1990 26 p Sponsored in part by EEC
(RUU-CS-90-10; ETN-90-98128) Avail: NTIS HC/MF A03

A routing scheme on dynamic networks called a prefix routing scheme is studied. The scheme is an abstraction of source routing. It assigns fixed addresses to the nodes and one address per link. Routing of messages is done by sending the messages out via the link with maximum common prefix with the destination node. Arbitrary insertions of links and nodes are feasible with constant adaptation cost. It is shown that any dynamic growing network can be assigned such a scheme. The type of fixed networks with dynamic links (i.e., the cost of the links can vary over time) and dynamic networks with arbitrary insertion and deletion of nodes

and links (without disconnecting the network) that allow optimum routing in this scheme are characterized completely. A hierarchical routing scheme where each link may carry more than one address is introduced and the connections between prefix routine and static interval routing are presented. ESA

N91-13155# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
THE FILE DISTRIBUTION PROBLEM FOR PROCESSOR NETWORKS
Goos Kant and Jan vanLeeuwen Apr. 1990 23 p Sponsored by EEC
(RUU-CS-90-16; ETN-90-98129) Avail: NTIS HC/MF A03

A segmentation problem for files in a network is investigated for the case of regular interconnection networks. The strict segmentation problem can be reduced to the problem of finding a strong coloring of the network with d + 1 colors, where d is the degree of the network. A strong coloring with d + 1 colors is proved possible for the d-dimensional hypercube under given specific conditions. The results show in which instances perfect segmentations are possible for classical regular processor interconnection networks. Some results for other regular and almost regular interconnection networks are included. ESA

N91-13156# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
A PSEUDO-POLYLOG AVERAGE TIME PARALLEL MAXFLOW ALGORITHM
Jop F. Sibeyn Apr. 1990 21 p Sponsored by Netherlands Foundation for Computer Science, and in part by EEC
(RUU-CS-90-17; ETN-90-98130) Avail: NTIS HC/MF A03

An algorithm for finding the maxflow of a directed graph with integer capacities is presented. The problem is explained and a sketch of the algorithm given. The algorithm is then worked out in a top down way. The results are proved as average over a suitable class of graphs and then generalized. A parallel machine (PRAM CREW) is used. The average calculation time is given. It is shown that the capacity condition does not really limit the applicability of the algorithm. ESA

N91-13157# Institut National Polytechnique, Grenoble (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et la Microscopie.
HERMITE NORMAL FORM OF MATRICES: CALCULATION AND PARALLELIZATION OF METHODS Ph.D. Thesis [NORMALE D'HERMITE: METHODES DE CALCUL ET PARALLELISATION]
Francoise Roch 1990 161 p In FRENCH; ENGLISH summary
(ETN-90-98202) Avail: NTIS HC/MF A08

The Hermite normal form of matrices and the parallelization of its computation are discussed. Both integral and polynomial cases are examined. This problem presents a classical feature of computer algebra algorithms: the intermediate coefficients swell. This particularity turns it into a test example to evaluate the gain brought by parallelization to computer algebra. Different sequential algorithms are presented. Their complexities are studied. A parallel approach is considered. The parallelization on experimental models is discussed. Different algorithms are developed, suited to distributed and shared memory models. Implementation is carried out on an hypercube FPS T40 (32 processors). The Hermite normal form of an 192 by 192 integral matrix is computed in seven hours. ESA

N91-13158# Institut National Polytechnique, Grenoble (France).
CONTRIBUTIONS TO RESEARCH IN ORDERED SETS: FROM SEQUENTIAL TO PARALLEL COMBINATIONS Ph.D. Thesis [CONTRIBUTIONS A LA RECHERCHE DANS DES ENSEMBLES ORDONNES: DU SEQUENTIAL AU PARALLELE]
Afonso GalvaoFerreira 1990 167 p In FRENCH; ENGLISH summary Sponsored by CAPES/COFECUB
(ETN-90-98203) Avail: NTIS HC/MF A08

The searching problem involved in sorted and partially sorted sets is discussed. Other related problems are reviewed. A survey of the selection, searching and sorting problems in X plus Y is presented. Some lower bounds are proved. Some upper bounds for the searching and selection problems in X plus Y are presented. How such results can be used in solving the knapsack decision problem is shown. Optimal speedup algorithms are given that run in different models of shared and distributed memory parallel machines. ESA

N91-12515# National Aerospace Lab., Tokyo (Japan).
SIMULATION OF A PARALLEL COMPUTER WITH A 2-DIMENSIONAL CFD PROGRAM
Koichi Harada, Masahiro Yosida, and Kinuyo Nakamura *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 13-17 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N91-13159# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.
GOAL RECONSTRUCTION: HOW TETON BLENDS SITUATED ACTION AND PLANNED ACTION
Kurt VanLehn and William Ball 3 Nov. 1989 50 p Submitted for publication Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678)
(AD-A225578; AIP-125) Avail: NTIS HC/MF A03 CSCL 12/9

This document discusses an extra capability that few cognitive architectures have, even though it is both useful from a programming point of view and arguably a good approximation to human capabilities. People can reconstruct goal structures and other aspects of their internal state that have been forgotten. For instance, suppose one is interrupted in the middle of solving a difficult problem by a long involved phone call. When the phone call is over, one can eventually pick up the problem solving where one left off. This capability is called goal reconstruction. Because goal reconstruction requires no special training to acquire it and it does not have to be acquired separately for each new problem solving procedure one learns, goal reconstruction is also a useful capability even for an artificial problem solver. It permits recovery from interruptions of the problem solving by processes that modify the body of procedural knowledge, such as an inferential learning process or a programmer debugging the procedural knowledge. In short, goal reconstruction is both a fundamental human capability and useful capability for artificial intelligent architectures. GRA

N91-13160# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
MODELLING HUMAN COGNITIVE DEVELOPMENT WITH EXPLANATION-BASED LEARNING IN SOAR Technical Report, 15 Sep. 1986 - 14 Sep. 1991
Tony Simon 2 Feb. 1990 16 p Prepared in cooperation with Pittsburgh Univ., PA
(Contracts N00014-86-K-0678; N00014-86-K-0349)
(AD-A225612; AIP-120) Avail: NTIS HC/MF A03 CSCL 12/9

Explanation-based learning (EBL) has been shown to be an effective method for operationalizing concepts implicit in a problem solver's knowledge base. Demonstrations have thus far used mainly deductive techniques over complete domain theories and with respect to limited tasks. This paper outlines some early work on augmenting EBL with a simple inductive capability and applying it to the real world domain of modelling the development of Piagetian number conservation concepts in children. The last few years has seen a profusion of work in EBL. The task of an EBL system is to accept a training instance and show that it is or it is not a

member of a given concept, thereby automating the classification process for future instances. This is done by problem solving over a domain theory which supports a mapping between the predicates of the training instance and those of the concept definition. Resulting generalizations must comply with an operationality criterion which limits the operationalized concept description to one which is easily evaluated for new instances. GRA

N91-13161# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
AUTOMATED ACQUISITION OF EVOLVING INFORMAL DESCRIPTIONS Ph.D. Thesis
Howard B. Rubenstein Jun. 1990 228 p Revised Sponsored by IBM; NYNEX Corp.; and Siemens Corp.
(Contract N00014-88-K-0487; NSF IRI-86-16644)
(AD-A225621; AI-TR-1205) Avail: NTIS HC/MF A11 CSCL 12/9

Much of human communication proceeds via an exchange of informal descriptions characterized by ambiguity, contradiction, and incompleteness. An automated system, the Listener, that unintrusively performs knowledge acquisition and informal input is described. The Listener develops a coherent internal representation of a description from an initial set of disorganized imprecise statements. Each statement provides fragmentary, ambiguous, possibly inconsistent information. The description and its implications are checked for consistency, completeness, and conclusions deemed interesting. The Listener interactively presents the results of these checks as a guide to continuing the acquisition process. The Listener also produces a summary document from its internal representation in order to facilitate communication, review, and validation. These behaviors are supported by a variety of techniques, including dependency-directed reasoning, hybrid knowledge representation, and the reuse of common forms (cliches). GRA

N91-13162# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
SWITCH: A SIMULATION OF REPRESENTATIONAL CHANGE IN THE MUTILATED CHECKERBOARD PROBLEM
Craig A. Kaplan 8 Dec. 1989 26 p Sponsored in part by IBM Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678)
(AD-A225720; AIP-108) Avail: NTIS HC/MF A03 CSCL 12/5

One of the best ways to study insight is to study problems that require shifts in representation. One such problem is The Mutilated Checkerboard (MC) problem. This report presents a brief psychological account of problem solving in the MC domain, followed by a detailed computer simulation of how change of representation might actually occur. The computer simulation, SWITCH, was build in the production system language, Soar. Analysis of how SWITCH works leads to psychological claims about problem solving strategies, representation, and the mechanism underlying representational change. Insight is that flash of illumination during which a problem solver exclaims Aha and sees (or thinks s/he see) the answer. To have an insight, one must first have a problem that constitutes something of a puzzle. If the problem is difficult for merely technical reasons (e.g., the following of a long and tedious algorithm), there is little room for insight. However, if the problem requires that one or more of its elements be thought of in a new way, then insight seems quite likely. There is good evidence that insight often follows rapidly after the problem solver represents the problem in a new way (Kaplan and Simon in press). Unfortunately, it's quite difficult to collect psychological data at the exact moment of insight, since human subjects are almost universally silent just before the AHA. GRA

N91-13163# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
LEARNING THE STRUCTURE OF EVENT SEQUENCES
Axel Cleeremans and James L. McClelland 11 Jun. 1990 41 p Sponsored in part by National Fund for Scientific Research, Belgium and National Inst. of Mental Health Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678)
(AD-A225722; AIP-109) Avail: NTIS HC/MF A03 CSCL 05/8

How is complex sequential material acquired, processed, and represented when there is no intention to learn. We report on two experiments exploring a choice reaction time task. Unbeknownst to subjects, successive stimuli followed a sequence derived from a noisy finite-state grammar. After considerable practice (60,000 exposures) with Experiment 1, subjects acquired a complex body of procedural knowledge about the sequential structure of the material. Experiment 2 attempted to identify limits on subjects' ability to encode the temporal context by using more distant contingencies that spanned irrelevant material. Taken together, the results indicate that subjects become increasingly sensitive to the temporal context set by previous elements of the sequence, up to three elements. Responses are also affected by priming effects from recent trials. A PDP model that incorporates sensitivity to the sequential structure and to priming effects is shown to capture key aspects of both acquisition and processing. GRA

N91-13164# Carnegie-Mellon Univ., Pittsburgh, PA.
USING AN INTELLIGENT TUTOR TO STUDY SKILL ACQUISITION Final Technical Report, 1 Oct. 1986 - 30 Sep. 1989
John R. Anderson 3 Aug. 1990 5 p
(Contract N00014-87-K-0103; NR Proj. RR0-4206)
(AD-A225763) Avail: NTIS HC/MF A01 CSCL 12/5

The LISP tutor is an intelligent tutoring system that facilitates students' acquisition of a complete repertoire of LISP skills. It has been used to study the acquisition of production rules which are the basic units of skill. The acquisition functions are in close conformity to the predictions of the ACT* theory. The immediate feedback aspect of the tutor has been compared with tutoring disciplines that are less directive. Generally, we find best learning with the highly directive form of the original tutor. However, there is some evidence for better performance if students have the opportunity to self correct. GRA

N91-13165# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
A CONNECTIONIST MODEL OF ATTENTIONAL ENHANCEMENT AND SIGNAL BUFFERING
Judith Shedden and Walter Schneider Jul. 1990 11 p Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678)
(AD-A225799; AIP-123) Avail: NTIS HC/MF A03 CSCL 12/7

The connectionist/control simulation of attentional enhancement, signal maintenance, and buffering of information is described. The system implements a hybrid connectionist architecture incorporating auto-association in the hidden layer and gain control of the hidden and output layer. The structure of the model parallels major features of modular cortical structure. The attentional selection simulation show that as one channel is attenuated, the system exhibits attentional capture in which only the more intense stimulus is transmitted to higher levels. The signal maintenance simulations show that small levels of auto-associative feedback can faithfully maintain short bursts of input for extended periods of time. With high auto-associative feedback, one module can buffer information from a pervious transmission while the module blocks the interference resulting from concurrent transmissions. The combination of auto-associative feedback and gain control allow extensive control of information flow in a modular connectionist architecture. GRA

N91-13166# California Univ., Los Angeles. Dept. of Mathematics, Science, and Engineering.
DISTRIBUTED PROBLEM SOLVING: ADAPTIVE NETWORKS WITH A COMPUTER INTERMEDIARY RESOURCE Interim Report, Oct. 1984 - Jun. 1988
John Lyman, Steven White, and Paul E. Young Jun. 1990 95 p
(Contract MDA903-84-C-0355; DA Proj. 74F)

(AD-A226346; ARI-RN-90-62) Avail: NTIS HC/MF A05 CSCL 12/7

Distributed problem solving networks are omnipresent decision-making structures with often untapped potential. The power of these networks cannot fully be recognized until the basic processes within the network are understood. A major source of disruptions in the network is the degradation of processes caused by uncertainty. Many uncertainty sources have technological solutions, such as increased sensor capability, increased communication bandwidth, or increased processing power. Inter-agent uncertainty is a more fundamental group dynamics problem without an obvious technological solution. Establishing and understanding inter-agent uncertainty reduction processes is necessary for a more effective utilization of the distributed problem-solving network. Forcing disagreeing agents to resolve their differences under control of a predefined set of rules is a proposed method of attacking this problem. The first report proposes a testbed design to study the process using input/output analysis. The difference resolving rules are inputs; the measures of group performance, the outputs. The second focus is the assessment programs/instructions. GRA

N91-13167# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

MODELING AND FEEDBACK CONTROL OF A FLEXIBLE ARM FOR PRESCRIBED FREQUENCY-DOMAIN TOLERANCES

Matei Kelemen and Arunabha Bagchi Jun. 1990 25 p
(MEMO-868; ISSN-0169-2690; ETN-90-98110) Avail: NTIS HC/MF A03

The problem of achieving quantitative specifications for the tip of a rotating flexible beam with uncertainty in some of its (physical and geometric) parameters is solved. The frequency domain design method used is helpful in clarifying some limitations on the feedback loop capabilities due to the distributed nature of the problem. Time domain simulations, while proving the validity of the design method suggested in the work, point to some interesting mathematical problems (concerning the influence of some of the parameters on the plant dynamics) with possible physical consequences on the design of flexible beams. ESA

N91-13168# Technische Univ., Berlin (Germany, F.R.). Fachbereich Informatik.

MODULARIZATION AND INTERPRETABILITY OF NEURAL NETS Ph.D. Thesis [ZUR MODULARISIERUNG UND INTERPRETIERBARKEIT NEURONALER NETZE]

Arnfried Ossen 1990 104 p In GERMAN
(ETN-90-98187) Avail: NTIS HC/MF A06

A contribution to the improvement of the efficiency and interpretability of neural nets was presented, while familiar methods of structurization for complex systems, in particular modularization, were applied to neural nets. A process was presented, allowing the development of module interfaces through the influence of neural net internal representations, well defined and interpretable coding was developed at interfaces. It was shown that modularized systems needed much less learning cycles than non modularized ones, and held the essential properties of a strong modularization, such as separated learning phases with any construction sequence, and interchangeability. ESA

N91-13169# Institut National Polytechnique, Grenoble (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.

CONTRIBUTION TO THE STUDY OF THE DYNAMICS OF AN AUTOMATA WITH MEMORY Ph.D. Thesis [CONTRIBUTION A L'ETUDE DE LA DYNAMIQUE D'UN AUTOMATE A MEMOIRE]

Driss Moumida 1989 162 p In FRENCH
(ETN-90-98205) Avail: NTIS HC/MF A08

The dynamics of an automata with memory in which the transition function is a step function are studied. The different properties allowing recognition of a function of a given step are reviewed. The main features involved in the dynamics automata with linear memories are outlined. The various families of automata with memories are reviewed, first the automata with palindromic memories, then those with reversible memories. The dynamics of the families of the automata with geometric memories are reviewed. An algorithm is presented which allows for the creation of automata with cycles more than twice the length of their memories. ESA

N91-13170# Oxford Univ. (England). Robotics Research Group.

DISTRIBUTED ARCHITECTURE FOR SENSING AND CONTROL OF A MOBILE ROBOT

Huosheng Hu Sep. 1990 65 p Sponsored by United Kingdom Science and Engineering Research Council
(OUEL-1836/90; ETN-90-98224) Avail: NTIS HC/MF A04

Research efforts towards developing a distributed computer architecture for sensing and control of the Turtle mobile robot are described. Navigation, sensor integration, real world modeling, planning, artificial intelligence and control are all discussed in the framework of the mobile robot project. The proposed architecture is composed of a layered perception systems and a layered control system. It is motivated by research on the subsumption architecture but includes significant modifications. The transputers used to implement the Turtle mobile robot layered sensing and control architecture are described. ESA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N91-13171# Oxford Univ. (England). Robotics Research Group.

PROJECTIVELY INVARIANT REPRESENTATIONS USING IMPLICIT ALGEBRAIC CURVES

David Forsyth, Joseph L. Mundy, Andrew Zisserman, and Christopher M. Brown May 1990 12 p Sponsored by United Kingdom Science and Engineering Research Council, and General Electric Coolidge Fellowship
(Contracts F30602-85-C-0008; DACA76-85-C-0001)
(OUEL-1829/90; ETN-90-97925) Avail: NTIS HC/MF A03

The computation of polynomial representations of image curves which are unaffected by the projective frame in which the representation is computed, is demonstrated. This means that the curve chosen to represent a projected set of points is the projection of the curve chosen to represent the original set. It is achieved by using algebraic invariants of the polynomial in the fitting process. The procedure is shown to work for plane conic curves. For higher order plane curves, or for aggregates of plane conics, algebraic invariants are shown to possibly yield powerful representations of shape that are unaffected by projection, and hence make good cues for model based vision. Tests on synthetic and real data yielded excellent results. ESA

N91-13172# Sandia National Labs., Albuquerque, NM. Applied Mechanics Div.

FINITE ELEMENT ERROR ESTIMATION AND ADAPTIVITY BASED ON PROJECTED STRESSES

Joseph Jung Aug. 1990 73 p
(Contract DE-AC04-76DP-00789)
(DE91-000483; SAND-90-0416) Avail: NTIS HC/MF A04

The behavior of a family of finite element error estimators is investigated based on projected stresses, i.e., continuous stresses that are a least squared error fit to the conventional Gauss point stresses. An error estimate based on element force equilibrium appears to be quite effective. Examples of adaptive mesh refinement for a one-dimensional problem are presented. Plans for two-dimensional adaptivity are discussed. DOE

N91-13173# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.

ON A LOCAL LIMIT THEOREM FOR LATTICE DISTRIBUTION

N. G. Gamkrelidze (Academy of Sciences of the Georgian SSR,

Tbilisi.) Feb. 1990 13 p
(CWI-BS-R9004; ETN-90-98068) Copyright Avail: NTIS HC/MF A03

The straightforward extension of the Local Limit Theorem (LLT) is given. In particular, a notion of the function of smoothness is introduced, its properties investigated and the sufficient conditions for the LLT are presented in terms of this function. Some counter examples are discussed where the initially plausible conjecture that the LLT holds turns out to be false. Numerical examples are given. ESA

N91-13174# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
ANALYSIS OF CHRISTOFIDES' HEURISTIC: SOME PATHS ARE MORE DIFFICULT THAN CYCLES
J. A. Hoogeveen Mar. 1990 10 p Submitted for publication
(CWI-BS-R9005; ETN-90-98069) Copyright Avail: NTIS HC/MF A02

For the traveling salesman problem in which the distances satisfy the triangle inequality, Christofides' heuristic produces a tour whose length is guaranteed to be less than 3/2 times the optimum tour length. The performance of appropriate modifications of this heuristic for the problem of finding a shortest Hamiltonian path is investigated. There are three variants of this problem, depending on the number of prespecified endpoints: zero, one, or two. It is not hard to see that, for the first two problems, the worst case performance ratio of a Christofides-like heuristic is still 3/2. For the third case, it is shown that the ratio is 5/3 and that this bound is tight. ESA

N91-13175# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
THE M/G/1 QUEUE WITH PROCESSOR SHARING AND ITS RELATION TO A FEEDBACK QUEUE
J. L. vandenBerg and O. J. Boxma Mar. 1990 33 p
(CWI-BS-R9006; ETN-90-98070) Copyright Avail: NTIS HC/MF A03

The central model studied is an M/M/1 queue with a general probabilistic feedback mechanism. When a customer completes his i-th service, he departs from the system with probability 1-p(i) and he cycles back with probability p(i). The mean service time of each customer is the same for each cycle. The joint distribution of successive sojourn times of a tagged customer at his loops through the system is determined. The mean service time at each loop is allowed to shrink to zero and the feedback probabilities approach one in such a way that the mean total required service time remains constant. The behavior of the feedback queue then approaches that of an M/G/1 processor sharing queue, different choices of the feedback probabilities leading to different service time distribution in the M/G/1 queue with processor sharing. Some variants are considered an M/M/1 feedback queue with additional customers who are always present, and an M/G/1 processor sharing queue with feedback. ESA

N91-13176# Illinois Univ., Urbana. Coordinated Science Lab.
PARALLEL SOLUTION OF SPARSE LINEAR SYSTEMS ON A VECTOR MULTIPROCESSOR COMPUTER M.S. Thesis
Pi-Yu Chung 30 Jul. 1990 82 p
(Contract N00014-84-C-0149)
(AD-A225377; UILU-ENG-90-2227; DAC-23) Avail: NTIS HC/MF A05 CSCL 12/1

This paper describes an efficient approach for solving sparse linear systems using direct method on a shared-memory vector multiprocessor computer. The direct method is divided into three steps: LU factorization, forward substitution and backward substitution. If the size of the linear system is large, LU factorization is a very time-consuming step, so that concurrency and vectorization are exploited to reduce execution time. Parallelism of LU factorization is obtained by partitioning the matrix using multilevel node-tearing techniques. The partitioned matrix is reordered into a NBBD (Nested Bordered-Block Diagonal) form. A nested-block data structure is used to store the sparse matrix, enabling the use of vectorization as well as multiprocessing to achieve high performance. This approach is suitable for many applications that require the repeated direct solution of sparse linear systems with identical matrix structure, such as circuit simulation. The approach has been implemented in a program that runs on an ALLIANT FX/8 vector multiprocessor with shared memory. Speedups in execution time compared to conventional serial computation with no vectorization are up to 20 using eight processors. GRA

N91-13177# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
ROBUST STABILITY AND PERFORMANCE FOR LINEAR SYSTEMS WITH STRUCTURED AND UNSTRUCTURED UNCERTAINTIES Final Report, Jul. 1988 - Apr. 1990
Rama Krishna Yedavalli and Y. Liu 21 Jun. 1990 55 p
(Contract F33615-88-C-3603; AF Proj. 2304)
(AD-A225697; WRDC-TR-90-3039) Avail: NTIS HC/MF A04 CSCL 12/4

This report documents research in the areas of stability and performance robustness. Stability robustness in the presence of structured and unstructured uncertainty is discussed relative to nonminimum phase systems. Simultaneous stabilization under unstructured uncertainties and nonconservative stability robustness bounds are addressed. Performance robustness is discussed using the D-Stability formulation. GRA

N91-13178# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
THE MATHEMATICAL BASES FOR QUALITATIVE REASONING
Yumi Iwasaki, Jayant Kalagnanam, and Herbert A. Simon Jan. 1990 25 p Prepared in cooperation with Pittsburgh Univ., PA
(Contract N00014-86-K-0678)
(AD-A225718; AIP-110) Avail: NTIS HC/MF A03 CSCL 12/9

Much reasoning about quantities takes place without use of mathematical formalisms, but solely in terms of ordinary language. A good deal of such qualitative reasoning makes implicit use of the properties of ordinal variables and monotonic transformations. An attempt is made to provide the formal foundations of qualitative analysis and to show how qualitative reasoning arises naturally and simply out of the structure of systems of algebraic equations and ordinary differential equations. The goal is to explicate, using familiar mathematical formalisms, the practices of researchers in many fields who use qualitative reasoning, and thereby to gain an understanding of the formal assumptions and mechanisms that underlie such analysis. Some of the properties of functions are sketched out along with specially continuous differentiable functions, that are invariant under monotonic transformations of the variables, and these properties are shown to be usable for analyzing phenomena where the variables are only defined ordinarily. GRA

N91-13179# Columbia Univ., New York, NY. Dept. of Mathematics.
APPLICATIONS OF MASSIVE MATHEMATICAL COMPUTATIONS Final Technical Report, 30 Sep. 1987 - 29 Jun. 1990
David V. Chudnovsky Apr. 1990 63 p
(Contract F49620-87-C-0113; AF Proj. 6120)
(AD-A225812; AFOSR-90-0862TR) Avail: NTIS HC/MF A04 CSCL 12/6

During the period of the grant our group has been using super-computers and parallel machines to solve important, large, and realistic problems. A distinctive characteristic of these problems, apart from their sheer size, is that they required the development of new algorithms which will be useful for other mathematical and physical problems, as well as for improvement of computer performance and reliability. GRA

N91-13180# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
ON THE SPECTRAL SLLN AND POINTWISE ERGODIC THEOREM IN L ALPHA
Christian Houdre Jul. 1990 28 p
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A225960; TR-302; AFOSR-90-0848TR) Avail: NTIS HC/MF A03 CSCL 12/3

The criterion, obtained by Gaposhkin, for a (weakly) stationary process to satisfy the strong law of large numbers (SLLN) has had various extensions, in particular to second order non-stationary harmonizable processes. Outside of the L squared-framework, it has also been studied for Fourier transforms of independently scattered symmetric alpha-stable (S alpha S) measures. It is shown here that via this spectral approach, neither the L squared - requirement nor any distributional assumption are indispensable in establishing the SLLN. Only the harmonic representation with respect to a bounded (in a sense to be made precise) random measure is crucial. This is illustrated, where conditions were obtained for the SLLN to hold for some classes of processes with finite alpha sub th-moment, which, in addition, are Fourier transforms. It is well known that stationary processes and unitary groups of operators are interchangeable, and so are the corresponding strong law and pointwise ergodic theorem. This type of duality between operators and processes carries over to the framework, although in general, the operators are not shifts. It is thus, also the purpose of the work to obtain the pointwise ergodic theorem, for some new classes of operators between L sub alpha-spaces, alpha between 1 and infinity. GRA

N91-13181# American Mathematical Society, Providence, RI.
THE 1989 AMS-SIAM SUMMER SEMINAR ON THE MATHEMATICS OF RANDOM MEDIA Final Report, 15 May 1989 - 14 May 1990
James W. Maxwell 14 May 1990 24 p Seminar held in Blacksburg, VA, 29 May - 9 Jun. 1989; cosponsored by Society for Industrial and Applied Mathematics
(Grants AF-AFOSR-0358-89; NSF DMS-88-14807; AF Proj. 6177)
(AD-A226141; AFOSR-90-0867TR) Avail: NTIS HC/MF A03 CSCL 12/3

The twentieth AMS-SIAM Summer Seminar on applied mathematics was held at Virginia Polytechnic Institute and State University, May 29 to June 9, 1989. The topic of the seminar was, The Mathematics of Random Media. The purpose of the seminar was to provide an overview of the role of applied probability theory in modeling the properties of materials and processes so complex that they can only be described statistically. Four general topics were selected for study; these were effective medium theory, diffusions and Markov processes, interesting particle systems and waves in random media. The seminar was structured so that each topic received about two and one-half days coverage (roughly 12 or 13 hourly presentations). One or two of the hourly talks at the beginning of each segment were aimed at providing general background and orientation for the audience. GRA

N91-13182# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
TRIMMED SUMS OF MIXING TRIANGULAR ARRAYS WITH STATIONARY ROWS
Makoto Maejima and Yuko Morita Mar. 1990 23 p
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A226257; AFOSR-90-0856TR) Avail: NTIS HC/MF A03 CSCL 12/3

Limit laws of trimmed sums are studied for triangular arrays of rowwise stationary random variables. It is shown that if the marginal distribution of the array belongs to the domain of attraction of an infinitely divisible law without Gaussian component, then the trimmed sum converges weakly to a nondegenerate random variable under some mixing and local dependence conditions. GRA

N91-13183# Naval Underwater Systems Center, New London, CT. Dept. of Environmental and Tactical Support Systems.
PARABOLIC EQUATION STARTING FIELD FOR A PROLATE SPHEROID SOURCE
Ghasi R. Verma (Rhode Island Univ., Kingston.) and E. Richard Robinson 20 Aug. 1990 13 p
(AD-A226281; NUSC-TD-8035) Avail: NTIS HC/MF A03 CSCL 12/2

Parabolic equations are used to calculate the propagation of sound over distance. To use parabolic equations, one must be able to specify the starting field. At close ranges, the acoustic source should not be considered as a point source. The starting field is derived for the special case of a prolate spheroid source in an infinite uniform half-space. GRA

N91-13184# Sandia National Labs., Albuquerque, NM.
USING POWER SERIES EXPANSIONS OF MODULI TO INTERPOLATE BETWEEN RELEASE CURVES FROM DYNAMIC TESTS: TECHNIQUE AND APPLICATION
M. D. Furnish Aug. 1990 43 p
(Contract DE-AC04-76DP-00789)
(DE91-000091; SAND-90-1291) Avail: NTIS HC/MF A03

Recently an appreciable number of continuous release profiles have been measured from dynamic experiments with geological materials. For each material an empirical generalization of the available release curves may be constructed to allow easy application of the experimental data to problems in much the same way as a linear shock velocity - particle velocity fit allows easy application of Hugoniot data. This generalization is made in two steps. The first is to compute the Eulerian axial modulus at the Hugoniot pressure and its first three pressure derivatives along the release for each test. This corresponds to a partial Taylor series of the axial modulus, which integrates to give a very close match to the original release. An alternative formulation, which takes volume as the independent variable, fails because that Taylor series does not converge with the rapidity needed for these calculations. The second step is to plot each of these quantities against the Hugoniot pressure for the suite of tests, and fit these data. A release from an arbitrary pressure within the general range of the experimental data may be computed by using the interpolated modulus and its interpolated derivatives. This generalization, which allows volume to be computed as a function of pressure, reproduces the experimental curves fairly well. We present the results of applying this technique to release data for Mini Jade 2 grout, and briefly compare these results with those from several Nevada Test Site tuffs, saturated and dry Indiana Limestone, and aluminum. Finally, we use the generalized Mini Jade 2 data to solve a sample problem, that of estimating the error produced by making the release = Hugoniot assumption in the analysis of ground motion gauges in an underground test. DOE

N91-13185# Brookhaven National Lab., Upton, NY. Mathematical Sciences Group.
FORECASTING CATASTROPHE BY EXPLOITING CHAOTIC DYNAMICS
H. B. Stewart and A. N. Lansbury (University Coll., London, England) 1990 25 p Presented at the EPRI Workshop on Applications of Chaos, San Francisco, CA, Dec. 1990
(Contract DE-AC02-76CH-00016)
(DE91-001118; BNL-45178; CONF-901246-2) Avail: NTIS HC/MF A03

Our purpose here is to introduce a variation on the theme of short term forecasting from a chaotic time series. We show that for the lowest-dimensional chaotic attractors, it is possible to predict incipient catastrophes, or crises, by examining time series data taken near the catastrophic bifurcation threshold, but always remaining on the safe side of the threshold. DOE

N91-13186# Brookhaven National Lab., Upton, NY.
PARALLEL MULTILEVEL PRECONDITIONERS
James H. Bramble, Joseph E. Pasciak, and Jinchao Xu 1989 17 p Presented at the 10th Conference on Differential Equations, Dundee, Scotland, 4-8 Jul. 1988 and the Society for Industrial

and Applied Mathematics 3rd Conference on Domain Decomposition Methods, Houston, TX, 20-22 Mar. 1989 Sponsored in part by ARO
(Contract DE-AC02-76CH-00016; NSF DMS-84-05352)
(DE91-001121; BNL-45180; CONF-8807172-2; CONF-8903169-4)
Avail: NTIS HC/MF A03

In this paper, we shall report on some techniques for the development of preconditioners for the discrete systems which arise in the approximation of solutions to elliptic boundary value problems. Here we shall only state the resulting theorems. It has been demonstrated that preconditioned iteration techniques often lead to the most computationally effective algorithms for the solution of the large algebraic systems corresponding to boundary value problems in two and three-dimensional Euclidean space. The use of preconditioned iteration will become even more important on computers with parallel architecture. This paper discusses an approach for developing completely parallel multilevel preconditioners. In order to illustrate the resulting algorithms, we shall describe the simplest application of the technique to a model elliptic problem. DOE

N91-13187# Rome Air Development Center, Griffiss AFB, NY.
SYNTHESIS OF MULTICHANNEL AUTOREGRESSIVE RANDOM PROCESSES AND ERGODICITY CONSIDERATIONS Report, Aug. 1989 - May 1990
James H. Michels Jul. 1990 205 p
(AF Proj. 4506)
(AD-A226493; RADC-TR-90-211) Avail: NTIS HC/MF A10
CSCL 12/2

In this paper, a method is presented for synthesizing multichannel autogressive random processes. The procedure allows for variable temporal and cross-correlation properties subject to specific constraint conditions for correlation functions. Expressions for the ergodic series are also developed providing a performance measure to specify the sample integration sizes required to achieve a specific variance of the time-averaged correlation function estimates. A unique aspect of this development is the determination of the functional dependence of the ergodic series in terms of the temporal correlation and variances of the processes. As a result, this analysis provides an analytic description which quantitatively assesses the ergodicity of the auto- and cross-correlation functions in terms of these fundamental process parameters. Thus, the variation of the process statistics based on time averages from those based on ensemble averages is given a more quantitative description than previously noted. GRA

N91-13188# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
THE BRST COMPLEX AS THE SQUARE ROOT OF THE CASIMIR OPERATOR
J. W. vanHolten Feb. 1990 9 p Sponsored by Stichting voor Fundamenteel Onderzoek de Materie
(NIKHEF-H/90-5; ETN-90-98053) Avail: NTIS HC/MF A02

The BRST cohomology of compact Lie algebras is investigated. An anti-BRST operator different from the one usually defined is introduced to construct a BRST invariant operator W, the zero modes of which are in one to one correspondence with the BRST cohomology. Solutions to the BRST cohomology conditions with different ghost numbers are shown to exist, all of which can be used to define a physical state space for a constrained quantum system. A connection with supersymmetric topological quantum theories is observed. ESA

N91-13189# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
THE BRST COMPLEX AND THE COHOMOLOGY OF COMPACT LIE ALGEBRAS
J. W. vanHolten Feb. 1990 26 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie
(NIKHEF-H/90-6; ETN-90-98054) Avail: NTIS HC/MF A03

The BRST and the anti-BRST operator for a compact Lie algebra which is a direct sum of abelian and simple ideals is constructed. Two different inner products are defined on the ghost space and the hermiticity properties of the ghost and BRST operators with respect to these inner products are discussed. A decomposition theorem of ghost states is derived and the cohomology of the BRST complex is shown to reduce to the standard Lie-algebra cohomology. The cohomology classes of the Lie algebra are shown to be given by all invariant antisymmetric tensors. How these can be obtained as zero modes of an invariant operator in the representation space of the ghosts is explained. Explicit examples are given. ESA

N91-13190# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
BRST FORMULATION OF THE GUPTA-BLEULER QUANTIZATION METHOD
Z. Hasiewicz, J. Kowalski-Glikman, J. Lukierski (Wroclaw Univ., Poland), and J. W. vanHolten Mar. 1990 27 p
(NIKHEF-H/90-7; ETN-90-98055) Avail: NTIS HC/MF A03

It is shown how an algebra of mixed first and second class constraints can be transformed into an algebra of the Gupta-Bleuler type, consisting of holomorphic and antiholomorphic constraints. Quantization by BRST methods is performed. A second level BRST operator Omega is constructed by introducing a new ghost sector (the second level ghosts), in addition to the ghosts of the standard BRST operator. An inner product in this ghost sector is found such that the operator Omega is hermitean. The physical states, as defined by the non hermitean holomorphic constraints, are shown to be given in terms of the cohomology of this hermitean BRST charge. ESA

N91-13191# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
SEMI-INFINITE OPTIMIZATION: STRUCTURE AND STABILITY OF THE FEASIBLE STABILITY
H. T. Jongen, F. Twilt, and G. W. Weber (Technische Hochschule, Aachen, Germany, F.R.) Dec. 1989 36 p
(Memo-838; ISSN-0169-2690; ETN-90-98099) Avail: NTIS HC/MF A03

An optimization problem of semi-infinite type has the following specific property: the feasible set is described by means of infinitely many inequality constraints. A study which considers semi-infinite optimization problems of a given form is presented. The (local) structure of feasible set and its topological stability are considered. The index set of inequality constraints is considered as possibly finite or a compact manifold with boundary. A central role is played by an appropriate extension of the Mangasarian-Fromovitz Constraint Qualification (MFCQ). Under assumption of this Extended MFCQ (EMFCQ), the set is shown to be a (Lipschitzian) manifold with boundary. If the set is compact then a corresponding set is homeomorphic if and only if EMFCQ is satisfied. The compactness of the set and validity of EMFCQ also guarantee the continuity of set-valued mapping. EMFCQ is proved to turn out generically true. ESA

N91-13192# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
SOME ORDER DIMENSION BOUNDS FOR COMMUNICATION COMPLEXITY PROBLEMS
U. Faigle and W. Kern Dec. 1989 17 p
(MEMO-839; ISSN-0169-2690; ETN-90-98100) Avail: NTIS HC/MF A03

A general (0,1) matrix M is associated with P(M), and lower and upper bounds for the deterministic communication complexity of M in terms of the order dimension of P(M) are derived. The special class of communication matrices M obtained as cliques versus stable sets incidence matrices of comparability graphs G is considered. Their complexity is bound by O((log d).(log n)), where n is the number of nodes of G and d is the order dimension of an orientation of G. In this special case, the bound is shown to improve other well-known bounds obtained for the general cliques versus stable set problem. ESA

N91-13193# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON RANDOM INTERVAL GRAPHS AND THE MAXIMUM THROUGHPUT RATE IN THE SYSTEM GI/G/1/0
Wim M. Nawijn Jan. 1990 19 p
(MEMO-840; ISSN-0169-2690; ETN-90-98101) Avail: NTIS HC/MF A03

An analysis of a random interval graph is presented which is the intersection graph of a family of random intervals. Based on a limit result for the expectation of a maximum stable set of the graph, the expectation of the maximum attainable fraction of served customers in the GI/G/1/0 loss system is given, under the assumption of perfect information about the future of the arrival and service processes. An asymptotic heavy traffic result for the fraction is derived, under the assumption of exponentially distributed service time. ESA

N91-13194# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON DISCRETE SIMPLEX SPLINES AND SUBDIVISION
M. Neamtu May 1990 47 p Sponsored by Netherlands Foundation for Mathematics, and Netherlands Organization for the Advancement of Research
(MEMO-860; ISSN-0169-2690; ETN-90-98102) Avail: NTIS HC/MF A03

A convenient way of approaching the problem of subdividing polynomial splines is to define the so-called discrete splines. This was successfully done in the univariate case and also in the multivariate case for polynomial splines on uniform grids, so called box splines. Discrete analogs of multivariate simplex splines i.e., splines that can be exploited on non-uniform grid partitions are introduced. Their study yields a subdivision scheme for simplex splines. ESA

N91-13195# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
A NONREGULAR SOLUTION ON THE NONLINEAR DYNAMIC DISTURBANCE DECOUPLING PROBLEM WITH AN APPLICATION TO A COMPLETE SOLUTION OF THE NONLINEAR MODEL MATCHING PROBLEM
H. J. C. Huijberts May 1990 23 p
(MEMO-862; ISSN-0169-2690; ETN-90-98104) Avail: NTIS HC/MF A03

The nonregular Dynamic Disturbance Decoupling Problem (nDDDP) for nonlinear control systems is presented. A local solution is given by means of a constructive algorithm that is based on Singh's algorithm and the clamped dynamics algorithm. The nonlinear Model Matching Problem (MMP) is studied. This problem is defined as follows: given a nonlinear control system, to be referred to as the plant, and another nonlinear control system, to be referred to as a model, can one find a compensator for the plant in such a way that the input-output behavior of the compensated plant matches that of the model. By proving that the solvability of the nonlinear MMP is equivalent to the solvability of an associated nDDDP a complete local solution of this problem is established. ESA

N91-13196# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON LEARNABILITY OF MONOTONE DNF FUNCTIONS UNDER UNIFORM DISTRIBUTION
U. Faigle and W. Kern May 1990 17 p
(MEMO-863; ISSN-0169-2690; ETN-90-98105) Avail: NTIS HC/MF A03

The learnability of monotone DNF functions in Valiant's model under uniform distribution is considered. It has been shown by Kearns et al that learning k-term monotone DNF functions (i.e., functions with k terms) is impossible for every k greater than or equal to 2, unless NP is equal to RP. It is shown that in the special case of uniform distribution, at least the case k is equal to 2 can be treated. ESA

N91-13197# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
A CLOSURE CONCEPT BASED ON DEGREE-SUMS OF INDEPENDENT TRIPLES
H. J. Broersma and I. Schiermeyer (Technische Hochschule, Aachen, Germany, F.R.) Jun. 1990 17 p
(MEMO-864; ISSN-0169-2690; ETN-90-98106) Avail: NTIS HC/MF A03

The closure concept of Bondy and Chvatal is reviewed. The concept is based on degree sums of pairs of nonadjacent vertices. A more general concept introduced by Ainouch and Christofides is shown to be able to be restated in terms of degree sums of independent triples. The concept is generalized. Simple graphs which have a Hamilton cycle are analyzed using the concept. The theories and proofs involved in the concept are outlined. ESA

N91-13198# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
CONSTRUCTING BIVARIATE SIMPLICIAL SPLINE SPACES OF CLASS C SUP 1
C. R. Traas Jun. 1990 12 p
(MEMO-870; ISSN-0169-2690; ETN-90-98111) Avail: NTIS HC/MF A03

Computation using bivariate quadratic simplicial splines has been hampered up to now by the necessity to perform the complex process of pulling apart. Using cubic simplicial splines while maintaining the requirement of smoothness of class C1, it is possible to devise a simple general rule for automatic pulling apart. This may lead to a more general acceptance of the simplicial spline as a tool in computation. ESA

N91-13199# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
THE PATHWIDTH AND TREEWIDTH OF COGRAPHS
Hans L. Bodlaender and Rolf H. Moehring (Technische Univ., Berlin, Germany, F.R.) Feb. 1990 14 p Sponsored in part by EEC (Grant DFG-Mo-446/1-1)
(RUU-CS-90-7; ETN-90-98126) Avail: NTIS HC/MF A03

The pathwidth of a cograph is shown to equal its treewidth. Application of pathwidths and treewidths covers areas such as algorithmic graph theory and very large scale integration design. A linear time algorithm to determine the pathwidth of a cograph and build a corresponding path decomposition is given. A number of interesting graph theoretic lemmas and theorems are given. ESA

N91-13200# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
QUASI CONCURRING REFLECTIONS AND SIMPLICITY CRITERIUM Ph.D. Thesis [QUASIKONFORME SPIEGELUNGEN UND SCHLICHTHEITSKRITERIEN]
Thomas Betker 1990 59 p In GERMAN
(ETN-90-98184) Avail: NTIS HC/MF A04

A Jordan area G with a quasiconcurring edge curve and a quasiconcurring reflection at this curve are considered. The object is to find criteria for the simplicity and the concurring continuity of a function f which is analytic (or meromorphic) in G. Direct demonstration methods are used, which neglect the regularity of the edge curve. The criteria of Krzyz and Becker were examined. Other results were obtained on the basis of the Loewner method by means of the Jacobi determinants. ESA

N91-13201# Grenoble-1 Univ. (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
FORMAL SOLUTIONS TO SETS OF ORDINARY HOMOGENEOUS LINEAR DIFFERENTIAL EQUATIONS Ph.D. Thesis [SOLUTIONS FORMELLES DE SYSTEMES D'EQUATIONS DIFFERENTIELLES LINEAIRES ORDINAIRES HOMOGENES]
1990 125 p In FRENCH; ENGLISH summary
(ETN-90-98199) Avail: NTIS HC/MF A06

Algorithms applied to calculating formal solutions to systems

of ordinary linear differential equations dependent on or independent of a single parameter are studied. The convergence of an algorithm is demonstrated. A program in MACSYMA is developed for the calculation of the Jordan form of holomorphic matrices under the I.1 hypothesis. An algorithm and a MACSYM program are developed for use in calculating the Arnold form of matrices dependent on parameters. The Arnold-Wasow form of differential systems dependent or not on one parameter is studied. ESA

N91-13202# Institut National Polytechnique, Grenoble (France).
PARALLEL HEURISTICS, PHYSICAL CRITERIA AND THEORETICAL PROBLEMS Ph.D. Thesis [MAILLAGE D'ESPACE: HEURISTIQUE PARALLELE, CRITRES PHYSIQUES ET PROBLEMS THEORIQUES]
Jean Mailfert 1990 105 p In FRENCH; ENGLISH summary (ETN-90-98201) Avail: NTIS HC/MF A06

Optimization of the tetrahedral meshes used in solving differential equations by a finite element method is studied. A parallel optimization algorithm for the topology of a random three dimensional space D, is presented. To avoid errors accumulating at interprocessor contacts and to avoid dependance on the initial separation of the domain, exchange of tetrahedra between neighboring processors is permitted. This auto-adaptive parallelization technique is tested experimentally on a hypercube T40 computer. A geometric optimization algorithm in two and three dimensions is described. ESA

N91-12561# National Aerospace Lab., Tokyo (Japan).
THE APPLICATION OF THE CONSISTENCY TO CHARACTERISTICS TO IMPLICIT DIFFERENCE APPROXIMATION
Hideaki Aiso *In its* Proceedings of the 7th NAL Symposium on Aircraft Computational Aerodynamics 1989 p 307-312 In JAPANESE; ENGLISH summary (For primary document see N91-12514 04-01)
Avail: NTIS HC/MF A14

N91-12600# Ship Research Inst., Tokyo (Japan).
THREE-D GRID GENERATION USING THE GEOMETRICAL METHOD
Yoshiaki Kodama *In* NAL, Proceedings of the 6th NAL Symposium on Aircraft Computational Aerodynamics Dec. 1988 p 55-60 In JAPANESE; ENGLISH summary (For primary document see N91-12591 04-02)
Avail: NTIS HC/MF A12

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N91-13203# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.
EIGENVALUE STATISTICS OF DISTORTED RANDOM MATRICES
Taksu Cheon Mar. 1990 12 p
(DE90-513782; INS-814) Avail: NTIS (US Sales Only) HC A03

Numerical study of a set of random matrices which interpolate Poisson and Gaussian orthogonal ensembles is reported. The result indicates that the transition from Poisson to Wigner distribution for the nearest level spacing does not depend on the detail of the random matrix parametrization and is essentially governed by a single parameter. Brody's one-parameter interpolation formula is found to describe the transition rather well. DOE

N91-13204# Stanford Univ., CA. Dept. of Statistics.
BOUNDS ON EXPECTATIONS OF ORDER STATISTICS FOR DEPENDENT SAMPLES
Donald R. Hoover 24 Jul. 1990 11 p
(Contract N00014-89-J-1627)
(AD-A225500; SU-TR-432) Avail: NTIS HC/MF A03 CSCL 12/3

Arnold and Groeneveld (1979) presented distribution free bounds for E(X(g:n)) the expected value of the 'gth' order statistic when sampling 'n' possibly dependent observations from populations each with finite expectations mu(i) and finite variances sigma squared(i). Here, the problem of incorporating known dependencies among the distributions of observations in a sample to produce bounds for the order statistics of that sample is considered. Limits are obtained for expectations of the 'gth' order statistic and the range. These limits hold even when the population variances are not finite. An application of the upper bound for E(X(n:n)) is given. GRA

N91-13205# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
ON PROBABILISTIC STRATEGIES FOR ROBOT TASKS Ph.D. Thesis
Michael Andreas Erdmann Mar. 1990 291 p Revised
(Contracts N00014-85-K-0124; N00014-86-K-0685)
(AD-A225714; AI-TR-1155) Avail: NTIS HC/MF A13 CSCL 12/9

Robots must act purposefully and successfully in an uncertain world. Sensory information is inaccurate or noisy, actions may have a range of effects, and the robot's environment is only partially and imprecisely modelled. This thesis introduces active randomization by a robot, both in selecting actions to execute and in focusing on sensory information to interpret, as a basic tool for overcoming uncertainty. An example of randomization is given by the strategy of shaking a bin containing a part in order to orient the part in a desired stable state with some high probability. Another example consists of first using reliable sensory information to bring two parts close together, then relying on short random motions to actually mate the two parts, when the part motions lie below the available sensing resolution. Further examples include tapping parts that are tightly wedged, twirling gears before trying to mesh them, and vibrating parts to facilitate a mating operation. Randomization is seen as a primitive strategy that arises naturally in a solution of manipulation tasks. Randomization is as essential to the solution of tasks as are sensing mechanics. An understanding of the way that randomization can facilitate task solutions is integral to the development of the theory of manipulation. Such a theory should try to explain the relationship between solvable tasks and repertoires of actions, with the aim of creating autonomous systems capable of existing in an uncertain world. GRA

N91-13206# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
BOOTSTRAPPING THE SAMPLE MEAN FOR DATA WITH INFINITE VARIANCE
Wei Wu, Edward Carlstein, and Stamatis Cambanis May 1990 44 p
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A225870; TR-296; AFOSR-90-0853TR) Avail: NTIS HC/MF A03 CSCL 12/3

When data comes from a distribution belonging to the domain of attraction of a stable law, Athreya (1987a) showed that the bootstrapped sample mean has random limiting distribution, implying that the naive bootstrap could fail in the heavy-tailed case. The goal here is to classify all possible limiting distributions of the bootstrapped sample mean when the sample comes from a distribution with infinite variance, allowing the broadest possible setting for the (nonrandom) scaling, the resample size, and the mode of convergence (in law). The limiting distributions turn out to be infinitely divisible with possibly random Levy measure, depending on the resample size. An averaged-bootstrap algorithm is then introduced which eliminates any randomness in the limiting distribution. Finally, it is shown that (on the average) the limiting distribution in the domain of (partial) attraction of a stable law. GRA

N91-13207# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
SAMPLING DESIGNS FOR ESTIMATING INTEGRALS OF STOCHASTIC PROCESSES USING QUADRATIC MEAN DERIVATIVES
Karim Benhenni and Stamatis Cambanis Apr. 1990 37 p
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A225961; TR-293; AFOSR-90-0852TR) Avail: NTIS HC/MF A03 CSCL 12/3

The problem of estimating the integral of a stochastic process by linear estimators based on observations of the process and its existing quadratic mean (q.m.) derivatives at a finite number of sampling points is considered. The process is assumed to have exactly K q.m. derivatives, K=O, 1,2,..... The asymptotic performance of optimal-coefficient estimators that depend on an inverse matrix is determined for regular sampling designs under slightly different assumptions than those in Sacks and Ylvisaker (1970). Simple-coefficient estimators based on a trapezoidal rule with a correction term that depends on the q.m. derivatives of the process at all sampling points of a regular design are introduced. Their asymptotic performance is identical to that of the optimal-coefficient estimators. GRA

N91-13208# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
HOELDER CONTINUITY OF SAMPLE PATHS OF SOME SELF-SIMILAR STABLE PROCESSES
Norio Kono and Makoto Maejima Mar. 1990 18 p
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A225989; TR-290; AFOSR-90-0846TR) Avail: NTIS HC/MF A03 CSCL 12/3

The Hoelder continuity of sample paths of the following classes of stochastic processes is examined: (1) Processes satisfying Kolmogorov's moment condition, (2) self-similar stable processes with stationary increments and (3) harmonizable fractional processes. GRA

N91-13209# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
CHARACTERIZATIONS OF ONE-SIDED FRACTIONAL LEVY MOTIONS
Stamatis Cambanis and Makoto Maejima Mar. 1990 16 p
(Contract F49628-85-C-0144; AF Proj. 2304)
(AD-A225990; TR-289; AFOSR-90-0844TR) Avail: NTIS HC/MF A03 CSCL 12/3

The only self-similar stable processes with stationary increments whose left-equivalent (resp. right-equivalent) stationary processes are nonanticipating (resp. fully anticipating) moving averages are the left (resp. right) linear fractional Levy motions. GRA

N91-13210*# Harvard Univ., Cambridge, MA. Dept. of Statistics.
CONSTRUCTION AND LOCAL COMPUTATION ASPECTS OF NETWORK BELIEF FUNCTIONS
A. P. Dempster 1990 22 p
(Contract NCC2-275; NSF DCR-85-13139)
(NASA-CR-180334; NAS 1.26:180334; AD-A226104; ARO-22964.10-MA) Avail: NTIS HC/MF A03 CSCL 12/1

Belief function methodology extends Bayesian reasoning about uncertainty to situations where the available evidence does not support a full probabilistic specification. A network belief function is constructed by combining independent component belief functions representing logical and probabilistic knowledge assessed locally across the network. Computational methods for combining (propagating and fusing) the local knowledge assessments are sketched. Examples are introduced without detailed formulas, including the Kalman filter, fault trees, and sampling inference. GRA

N91-13211# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering
REDUCED DEGREE OF FREEDOM MINIMUM VARIANCE SPECTRUM ESTIMATION
Minjoong Rim and Barry VavVeen 1989 6 p
(Contract DAAL03-89-K-0141; NSF MIP-89-58559)
(AD-A226466; ARO-26460.2-EL) Avail: NTIS HC/MF A02 CSCL 17/9

The order N minimum variance spectrum estimator has N-1 degrees of freedom. Techniques from partially adaptive beamforming are used to reduce the degrees of freedom to M where M is less than N-1. The benefits of reducing degrees of freedom include reduced estimator variance, potential for improved resolution, and in some cases reduced computational complexity. Assuming that multiple observations of independent data vectors are used to estimate the covariance matrix, it is shown that reducing degrees of freedom decreases the bias and variance of the estimator. Given a single data record, reducing degrees of freedom enlarges the maximum permissible estimator order and thus provides potential for improved resolution. We also show that the reduced degree of freedom estimator offers substantial computational savings if the power at only several frequencies is estimated. Simulations are provided to support the analytical results. GRA

N91-13212# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
THE LIKELIHOOD RATIO FOR MULTI DIMENSIONAL GAUSS-MARKOV RANDOM FIELDS
Rob Luesink May 1990 23 p
(MEMO-861; ISSN-0169-2690; ETN-90-98103) Avail: NTIS HC/MF A03

A discrete Gauss-Markov random field is written as a nearest neighbor model with a special structure of the noise term. The likelihood ratio for these fields is derived. It contains the determinant and inverse of the covariance matrix of the field. Even for small samples, this matrix may have large size. This implies that maximization of the likelihood ratio with respect to unknown parameters demands high computational efforts. For a class of fields (stationary and cyclic) the computation of this determinant and inverse of the covariance matrix can be circumvented by block diagonalization. ESA

N91-13213# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ESTIMATION OF EXPECTATIONS AND COVARIANCE MATRICES WITH LINEAR STRUCTURE
K. Poortema Jun. 1990 29 p
(MEMO-866; ISSN-0169-2690; ETN-90-98108) Avail: NTIS HC/MF A03

Estimation with respect to stochastic vectors having linear structure with respect to their expectations and covariance matrices is studied. An iteration procedure of Anderson is modified in order to cover the case of stochastic vectors X sub i that are not identically distributed. Consistency results are established under quite general conditions. Asymptotic efficiency is proved assuming normal distributions. ESA

N91-13214# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
FACTORIZATION OF NONLINEAR SYSTEMS
Henk Nijmeijer Jun. 1990 13 p Submitted for publication
(MEMO-867; ISSN-0169-2690; ETN-90-98109) Avail: NTIS HC/MF A03

A concept of factor distribution for a nonlinear system is introduced as a tool for studying the decomposition of such a system. The idea of factorizing generalizes a similar idea from linear system theory as well as the notion of controlled invariance for nonlinear systems. The analysis presented is concluded to be by no means complete. Further research is needed to gain a full understanding of nonlinear factorization. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N91-13215# General Accounting Office, Washington, DC. National Security and International Affairs Div.
MILITARY SPACE PROGRAMS: AN UNCLASSIFIED OVERVIEW OF DEFENSE SATELLITE PROGRAMS AND LAUNCH ACTIVITIES
Jun. 1990 97 p
(AD-A225014; GAO/NSIAD-90-154FS) Avail: NTIS HC/MF A05 CSCL 22/2

This fact sheet reflects the unclassified DoD satellite program and launch plans to the extent they existed as of October 1, 1989, for activities through year 2004. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N91-13216# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
INTERACTING HILBERT SPACE VALUED STOCHASTIC DIFFERENTIAL EQUATIONS AND PROPAGATION OF CHAOS
G. Kallianpur and R. L. Karandikar Jul. 1990 45 p
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A225991; TR-304; AFOSR-90-0849TR) Avail: NTIS HC/MF A03 CSCL 12/2

Interacting Hilbert space valued stochastic differential equations are studied as an extension of Funaki's model for random strings to a system of interacting strings. The martingale problem for the corresponding McKean-Vlasov equation is solved. Special results when H = L squared (G), G, a bounded domain in real numbers are obtained. GRA

N91-13217# Technische Univ., Darmstadt (Germany, F.R.). Fachbereich Mathematik.
CONTRIBUTIONS TO THE THEORY OF ELLIPTIC PSEUDODIFFERENTIAL OPERATORS ON MANIFOLDS WITH NONSMOOTH BOUNDARIES Ph.D. Thesis
Reinhold Schneider 1989 58 p
(ETN-90-98165) Avail: NTIS HC/MF A04

The invertibility or Fredholm properties of nonclassical multidimensional singular integral operators is investigated with the continuity given by definition. The main theorem and basic algebra are presented. Bessel potential operators for canonical Lipschitz domains are investigated. A Bessel potential operator for the first octant is given. Theorems for the reduction of order for related Wiener-Hopf operators are given. ESA

N91-13218# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
THE SEMICLASSICAL LIMIT OF THE BERRY PHASE Ph.D. Thesis [UEBER DEN SEMIKLASSISCHEN LIMES DER BERRYSCHEN PHASE]
Joachim Asch 1990 56 p In GERMAN
(ETN-90-98185) Avail: NTIS HC/MF A04

The Berry phase is a physical quantity which can be calculated by integration of a characteristic class. An integrable system is described by a family of Weyl-Hamilton functions. Calculations are made with coordinate-free formula. The possible asymptotic development of the semiclassical limit of a 2-form is considered if the system has only one degree of freedom. These calculations are useful in depicting adiabatic changes. ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N91-13219*# Georgia Inst. of Tech., Atlanta. Electronics and Computer Systems Lab.
A COMPLEX PERMITTIVITY AND PERMEABILITY MEASUREMENT SYSTEM FOR ELEVATED TEMPERATURES Final Report, Dec. 1989 - Jul. 1990
Paul Friederich 1990 57 p
(Grant NAG3-972)
(NASA-CR-187240; NAS 1.26:187240) Avail: NTIS HC/MF A04 CSCL 20C

The three goals of this research include: (1) to fully develop a method to measure the permittivity and permeability of special materials as a function of frequency in the range of 2.6 to 18 GHz, and of temperature in the range of 25 to 1100 C; (2) to assist LeRC in setting up an in-house system for the measurement of high-temperature permittivity and permeability; and (3) to measure the complex permittivity and permeability of special materials as a function of frequency and temperature to demonstrate the capability of the method. The method chosen for characterizing the materials relies on perturbation of a resonant cavity with a small volume of sample material. Different field configurations in the cavity can be used to separate electric and magnetic effects. The cavity consists of a section of rectangular waveguide terminated at each end of a vertical slot iris. In the center of one wall is a small hole through which the sample is introduced. Author

N91-13220# Gas Research Inst., Chicago, IL.
PHYSICAL SCIENCES PROGRAM AREA 1990 CONTRACT STATUS REPORT
D. A. Dolenc Jul. 1990 256 p
(PB90-252545; GRI-90/0181) Avail: NTIS HC/MF A12 CSCL 20C

The 1990 status of research contracts funded and managed by GRI's (Gas Research Institute) Physical Science Department is summarized. Eleven research areas are grouped according to the elements of GRI's mission: gas supply options (geosciences, advanced gas separation science and technology); end use (combustion, heat and mass transfer science, energy conversion fundamentals, high-temperature materials, and methane reaction science); gas operations (piping materials research, gas flow research); and crosscutting research (properties research, exploratory concepts). The description of each contract includes the reasons for funding the research, its objectives, and a statement of accomplishments. GRA

N91-13221# California Univ., San Diego, La Jolla. Dept. of Physics.
LARGE MOTIONS OF THE MAGNETIZATION IN MAGNETICALLY ORDERED MEDIA Final Report, 1 Oct. 1988 - 30 Sep. 1989
Harry Suhl 1989 4 p
(Contract N00014-87-K-0059)
(AD-A226084) Avail: NTIS HC/MF A01 CSCL 20/3

Most of the effort was directed towards an application of modern techniques of nonlinear physics to problems in magnetism at the level of classical magnetization fields. That effort was distributed as follows: (1) high power ferromagnetic resonance; (2) chaotic motion of ferromagnetic domain walls; (3) morphology of domain structures in subsaturating magnetic fields; and (4) self-organized critical states of domain wall configurations. GRA

N91-13222# Sandia National Labs., Albuquerque, NM. Measurement Standards, Calibration and Photography Div.
DESIGN OF A DUAL PORT VOLUME MEASURING SYSTEM
Paul A. Klevgard Sep. 1990 84 p
(Contract DE-AC04-76DR-00789)
(DE91-000883; SAND-90-8224) Avail: NTIS HC/MF A05

A volume measuring system is described which uses the ideal gas law and pressure measurements to determine an unknown vessel's volume when a gas expands into that vessel from a known volume. The design, the engineering principles, the calibration, and the accuracy of this computer-controlled system are all discussed. A set of electrical and mechanical drawings of the system is included. DOE

N91-13223# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
THREE-DIMENSIONAL COMPUTATION OF MAGNETIC FIELDS AND LORENTZ FORCES OF AN LHC DIPOLE MAGNET
C. Daum and D. terAvest (Universiteit Twente, Enschede, Netherlands) Jul. 1989 57 p Sponsored in part by Netherlands Foundation for Technical Research
(NIKHEF-H/89-12; LHC-Note-94; ETN-90-98051) Avail: NTIS HC/MF A04

Magnetic fields and Lorentz forces of a Large Hadron Collider (LHC) dipole magnet are calculated using the method of image currents to represent the effect of the iron shield. The calculation is performed for coils of finite length using a parametrization for coil heads of constant perimeter. A comparison with calculations based on POISSON and TOSCA is made. ESA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N91-13224# Fichtel und Sachs, Schweinfurt (Germany, F.R.).
INVESTIGATION OF ACTIONS TO REDUCE NOISE EMISSIONS IN ULTRALIGHT AIRCRAFTS
Klaus Krappmann, Klaus Lueck, Manfred Maethner, Uwe Meining, and Hans-Juergen Schmid Jan. 1989 145 p In GERMAN; ENGLISH summary Sponsored by Umweltbundesamt
(UBA-FB-105-05-303; ETN-90-97890) Avail: NTIS HC/MF A07

Based on a special Fichtel and Sachs flight engine, the prototype of a low noise ultralight drive was developed, while the minimum climb rate of 1,5 m/s could be maintained. The objective was a flyover noise level of 50 dB(A) at a height altitude of 150 m, at maximum engine power. With in depth research work and a great number of actions taken both on the engine and on the airscrew, 60 dB(A) could be achieved. Comparative values measured in a commercial quality label device show how problematic it is to meet the currently established limit of 55 dB(A). It appears that further development work on the drive and the integration into an aerodynamically optimized flight device would allow one to go below the current limit. The objective of 50 dB(A) does not seem achievable at present, if the flight fitness has to be fully maintained. ESA

N91-13225# David Taylor Research Center, Bethesda, MD. Dept. of Propulsion and Auxiliary Systems.
DESIGNING A NEGLIGIBLE REFLECTION COEFFICIENT FOR A UNIFORM PANEL WITH COMPLIANT LAYER Final Report
G. Maidanik and J. Dickey Jul. 1990 35 p
(AD-A225708; DTRC-90/022) Avail: NTIS HC/MF A03 CSCL 20/1

The use of a mechanical compliant layer to achieve a negligible reflection coefficient atop a uniform panel facing a fluid and backed by a vacuum is investigated. The material properties of the compliant layer that need to be maintained to achieve the set goal are specified in terms of the surface stiffness and the loss factor of the layer. A necessary relationship between these quantities emerges. GRA

N91-13226# Army Lab. Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.
EVALUATION OF ACCELERATION-INDUCED PHASE NOISE IN SURFACE ACOUSTIC WAVE DEVICES Technical Report, Jan. 1989 - Jan. 1990
John Kosinski, Arthur Ballato, and Theodore Lukaszek Mar. 1990 15 p
(AD-A226027; SLCET-TR-90-3) Avail: NTIS HC/MF A03 CSCL 09/4

Stable local oscillators based on surface acoustic wave (SAW) resonators have been proposed for future use in Army electronic systems designed for airborne and vehicular applications. The vibration spectra of these systems in conjunction with the vibration sensitivity of the SAW resonators leads to a degradation in oscillator phase noise, which may then exceed the total allowable system phase noise. This report details a study of the vibration-induced phase noise in a group of SAW oscillators developed for a low-noise radar application. GRA

N91-13227# Naval Postgraduate School, Monterey, CA.
ACOUSTIC INTERACTIONS IN ARRAYS OF SPHERICAL ELASTIC SHELLS
C. L. Scandrett and David R. Canright 11 Jun. 1990 27 p
(AD-A226091; NPS53-90-009) Avail: NTIS HC/MF A03 CSCL 17/1

The acoustical performance of a submerged linear array of spherical transducers is examined by combining the T-Matrix method of solving for multiple acoustic interactions among separate bodies with a model for the transducers as thin spherical elastic shells. This approach solves the fully coupled problem of the response of the array to internal forcing. The results show that the assumptions giving rise to the Chebyshev criteria for optimal arrays of point sources appear to apply well even for large spheres at low frequencies. However, at frequencies near or above the lowest resonant frequency the directional pattern may be degraded, depending on the material of the shells. GRA

N91-13228# Admiralty Research Establishment, Gosport (England).
FORTRAN PROGRAM FOR SOUND SCATTERING BY LAYERED ISOTROPIC CYLINDER
J. H. James Mar. 1990 17 p
(AD-A226321; ARE-TR-90302; DRIC-BR-114135) Avail: NTIS HC/MF A03 CSCL 20/1

Skelton's original FORTRAN program for predicting time-harmonic sound radiation from an infinite cylinder comprising elastic, viscous and acoustic layers has point forces and monopoles as excitations. It has been extended to cover the case of excitation by a plane wave at arbitrary incidence, and the output may be used for transient radiation/scattering studies. Numerical examples are given, but a computer listing is not included. GRA

N91-13229# Pennsylvania State Univ., University Park. Applied Research Lab.
MEASUREMENT OF THE COMPLEX REFLECTIVITY OF SUBMERGED THIN PLATES AT OBLIQUE INCIDENCE ANGLES USING THE TWO-SENSOR INTENSITY TECHNIQUE
D. W. DeVilbiss and A. D. Stuart Aug. 1990 122 p
(Contract N00039-88-C-0051)
(AD-A226352; PSU/ARL-TR-90-012) Avail: NTIS HC/MF A06 CSCL 17/1

This study has involved the adaptation of the two-sensor acoustic intensity measurement method to an underwater environment. The intensity technique involves measuring the acoustic pressure at two closely spaced points. The average of the pressures approximates the pressure at the midpoint of the two sensors while the difference between the pressures and the application of the Euler's equation leads to an approximation for the acoustic particle velocity at the midpoint between the two sensors. These two quantities, the acoustic pressure and the acoustic particle velocity, are all that is needed to approximate the acoustic intensity and the acoustic impedance. The objective of this research was to develop the system and use it to measure the complex reflectivity of submerged thin plates at non-normal angles of incidence. The two-sensor technique has advantages over more conventional methods of measuring the reflectivity in that the sensors need only be positioned once during the test. This leads to a savings in effort and time for the experimenter. The source of acoustic energy used to ensonify the plates took

the form of a parametric or virtual and fire array. The parametric array is formed by exciting a transducer with a high frequency carrier signal which has been amplitude modulated with a low frequency signal. GRA

N91-13230# Pennsylvania State Univ., University Park. Applied Research Lab.
A THEORETICAL ANALYSIS OF AIRBORNE SOUND TRANSFER FROM RESILIENTLY MOUNTED MACHINE TO ITS FOUNDATION
M. F. Shaw and C. B. Burroughs Sep. 1990 98 p
(Contract N00039-88-C-0051)
(AD-A226487; PSU/ARL-TR-90-013) Avail: NTIS HC/MF A05
CSCL 17/1

The airborne transmission loss across resilient mounting systems is investigated by developing an analytic model of the transmission of vibration from a point-driven, simply supported plate to a parallel infinite plate through the air separating the plates. Predictions of airborne transmission losses are compared with transmission losses through resilient mounts to quantify the role of the airborne path in transmission losses through well designed, single-stage resilient mounting systems. The sensitivity of the airborne transmission losses to separation distance, thickness of the receiving plate, size of the driven plate and damping in the plates is presented. GRA

N91-13317*# Hampton Univ., VA. Dept. of Mathematics.
ACOUSTIC WAVES SUPERIMPOSED ON INCOMPRESSIBLE FLOWS
Steve Hodge *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 56-57 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20A

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N91-13231# Nagasaki Univ. (Japan). Plasma Science Center.
HIGH-ENERGY PROTONS PRODUCED BY A LARGE-AMPLITUDE MAGNETOSONIC WAVE AND ASSOCIATED GAMMA RADIATION THROUGH NEUTRAL PION DECAY
Y. Ohsawa and Y. Terashima Feb. 1990 37 p
(DE90-520190; PSC-6) Avail: NTIS (US Sales Only) HC A03

Spectra of ions accelerated by a large-amplitude magnetosonic wave and spectra of gamma radiation from the decay of neutral pions which are produced in energetic ion collisions are studied through particle simulations and numerical calculations. A large-amplitude magnetosonic wave can promptly accelerate ions to relativistic energies for a rather strong magnetic field (omega(sub ce) approximately greater than omega(sub pe)). This acceleration is much more rapid and efficient than usual stochastic acceleration and can occur in solar flares. Ion spectra thus generated can have various shapes depending on some plasma parameter. The maximum energy is, however, well defined, and ion spectra have strong downward curvatures near the maximum values. Further, a particle simulation shows that this mechanism can produce a (truncated) power-law form with a spectral index s = 1.2. Energy spectra of gamma radiation are then numerically obtained for this type of ion energy spectrum and for the modified Bessel function forms derived from a stochastic acceleration model. Power-law forms of ion spectra produce much harder photon energy-spectra than the modified Bessel function forms. DOE

N91-13232# Theoretical and Physical Chemistry Inst., Athens (Greece).
POTENTIAL ENERGY SURFACES AND STABILITY OF HIGH ENERGY CONTENT EXCITED BOUND CLUSTERS Final Scientific Report, 1 Aug. 1987 - 31 Mar. 1990
C. A. Nicolaides 18 Jun. 1990 11 p
(Grant AF-AFOSR-0348-87)
(AD-A224611; AFOSR-90-0764TR) Avail: NTIS HC/MF A03
CSCL 20/5

The work moved along three directions whose choice was made in order to increase the understanding of the concepts of molecular energy content and stability. The direction involved first the computation of accurate adiabatic potential energy surfaces (PES) and vibrational analysis of high energy content clusters in ground and excited states in geometries of intramolecular charge transfer which give rise to closely avoided regions. These geometries are predicted a priori according to the published maximum ionicity in the excited state (MIES) theory. GRA

N91-13233# Oregon Univ., Eugene.
ENERGETIC X RAY PROCESSES IN ATOMS Final Technical Report, 15 Jan. 1987 - 30 Jun. 1990
Bernd Crasemann 10 Jul. 1990 9 p
(Grant AF-AFOSR-0026-87; AF Proj. 2301)
(AD-A224997; AFOSR-90-0835TR) Avail: NTIS HC/MF A02
CSCL 20/5

Properties of highly stripped ions have been computed relativistically in intermediate coupling with configuration interaction, including quantum electrodynamic effects. Charged-particle ionization cross sections have been calculated, including effect of autoionizing resonances on electron-impact excitation rates. Dielectronic recombination rates have been calculated. An extensive computation of relativistic Auger radial matrix elements has been performed; the results can be used to calculate radiationless transition rates in multiple ionized atoms and are expected to be very useful for the computation of Auger rates in molecules. GRA

N91-13234# Army Armament Research, Development and Engineering Center, Watervliet, NY.
DIFFRACTION MODELS, DYNAMICAL STRUCTURE TENSORS, AND ELECTRON-PHONON INTERACTION Final Report
L. V. Meisel Jul. 1990 26 p
(AD-A225953; ARCCB-TR-90019) Avail: NTIS HC/MF A03
CSCL 20/5

A coherent exposition of the theory of scattering from a dynamic lattice, which applies to the scattering of Bloch wave electrons as well as the scattering of plane waves, is presented. This is achieved by developing a generalized diffraction model, along the lines conceived by Van Hove, appropriate for the scattering of Bloch waves. The resulting diffraction model provides a basis for treating processes controlled by electron-phonon interaction in general and subsumes the standard diffraction model results. The diffraction model origins of the standard approximate expressions used to describe electron-phonon interaction controlled processors are also revealed. GRA

N91-13235# Duke Univ., Durham, NC. Dept. of Physics.
SPECTROSCOPIC INVESTIGATIONS OF NONAMBIENT SYSTEMS WITH MILLIMETER AND SUBMILLIMETER PROBES Final Report, 8 Jan. 1986 - 2 Jan. 1990
Frank C. DeLucia 28 Jun. 1990 35 p
(Contract DAAL03-86-K-0147)
(AD-A226201; ARO-24453.7-PH) Avail: NTIS HC/MF A03
CSCL 20/5

The project, Spectroscopic Investigations of Nonambient Systems with Millimeter and Submillimeter Probes, addressed a broad range of scientific topics and technological developments important to this spectral region. For the purposes of this discussion, we have divided the report on research results into three parts: (1) Energy transfer in polyatomic molecules, especially those of importance in far infrared lasers; (2) Molecular collisional processes at very low temperature (5 K), and (3) Development and uses of millimeter and submillimeter technology. Also included is a list of personnel who worked on these projects. This project addressed the development and use of spectroscopic techniques for the study of molecular systems under nonambient conditions. Emphasis was placed on the use of millimeter and submillimeter spectroscopic methods as diagnostic probes of these environments

although many of these techniques are also applicable in other spectral regions. In some cases, the mm/submm spectral region was especially advantageous for the work while in others it was merely convenient because of our experience and equipment base in this part of the spectrum. GRA

N91-13236# Naval Research Lab., Washington, DC.
OVERVIEW OF BEAM CONDITIONING Interim Report
R. F. Fernsler, A. W. Ali, P. Boris (Science Applications International Corp., McLean, VA.), R. F. Hubbard, and G. Joyce 31 Aug. 1990 36 p
(AD-A226404; NRL-MR-6680) Avail: NTIS HC/MF A03 CSCL 20/7

This report contains five short papers summarizing theoretical studies of various techniques for conditioning relativistic electron beams. Conditioning refers to processes that either damp transverse fluctuations of the beam, or provide a head-to-tail variation in its emittance. The studies were performed in support of beam propagation experiments being conducted at several laboratories. GRA

N91-13237# Los Alamos National Lab., NM. Physics Div.
MEASUREMENT OF THE ABSOLUTE CROSS SECTION FOR MULTIPHOTON IONIZATION OF ATOMIC HYDROGEN AT 248 nm
George A. Kyrala and T. David Nichols 1990 15 p Presented at the 5th International Conference on Multiphoton Processes, Paris, France, 24-28 Sep. 1990
(Contract W-7405-eng-36)
(DE91-000222; LA-UR-90-3210; CONF-900926-1) Avail: NTIS HC/MF A03

We present measurements of the absolute rates for multiphoton ionization of the ground state from atomic hydrogen by a linearly polarized, subpicosecond KrF laser pulse at a wavelength of 248 nm. A laser crossed atomic beam technique is used. The irradiance was varied from 3 x 10(exp 12) to 2 x 10(exp 14) w/sq cm and three above threshold ionization peaks were observed. The measured rate for total electron production is less than predicted by the numerical and perturbation calculations, but significantly higher than calculated by the Reiss and Keldysh methods. DOE

N91-13238# Oak Ridge National Lab., TN. Controlled Fusion Atomic Data Center.
ATOMIC DATA FOR FUSION. VOLUME 1: COLLISIONS OF H, H2, He AND LI ATOMS AND IONS WITH ATOMS AND MOLECULES
Clarence F. Barnett, Hamilton T. Hunter, ed., M. Imogene Fitzpatrick, ed., I. Alvarez, ed., C. Cisneros, ed. (Universidad Nacional Autonoma de Mexico, Mexico City.), and Ronald A. Phaneuf, ed. Jul. 1990 706 p
(Contract DE-AC05-84OR-21400)
(DE91-000527; ORNL-6086-Vol-1) Avail: NTIS HC/MF A99

This report provides a handbook of recommended cross-section and rate-coefficient data for inelastic collisions between hydrogen, helium and lithium atoms, molecules and ions, and encompasses more than 400 different reactions of primary interest in fusion research. Published experimental and theoretical data have been collected and evaluated, and the recommended data are presented in tabular, graphical and parametrized form. Processes include excitation and spectral line emission, charge exchange, ionization, stripping, dissociation and particle interchange reactions. The range of collision energies is appropriate to applications in fusion-energy research. DOE

N91-13239# Brookhaven National Lab., Upton, NY. Dept. of Chemistry.
HIGH PRESSURE EFFECTS ON THE PROPERTIES AND REACTIONS OF EXCESS ELECTRONS IN HYDROCARBONS
Richard Holroyd and Masaru Nishikawa (Tokyo Univ., Japan) 1990 6 p Presented at the 5th Working Meeting on Radioactive Interactions, Leipzig, Fed. Republic of Germany, 24-28 Sep. 1990
(Contract DE-AC02-76CH-00016)
(DE91-000578; BNL-45214; CONF-9009263-1) Avail: NTIS HC/MF A02

These studies, utilizing high pressure, have provided considerable insight into the mechanism of electron transport and electron reactions in hydrocarbon liquids. Electrostriction leads to a significant negative volume change (about minus 20 cm(exp 3)/mol) for electron trapping in alkanes. Electrostriction around an ion is even greater (minus 100 to minus 200 cm(exp 3)/mol). This effect and the fact that the energy level of the electron increases with pressure both contribute to shifts in electron attachment equilibria to favor ions at high pressure. Considerable effort has gone into studies of the mobility, properties and reactions of electrons in nonpolar liquids at or near normal pressures. Only recently have studies been undertaken of the effect of high pressure (up to 3 kbar) on electron behavior in such liquids. Pressures of this magnitude change the electron mobility in both alkane and aromatic liquids, and affect the ground state energy of electrons and stability of ions, which cause changes in the rates of electron reactions. DOE

N91-13240# Oak Ridge National Lab., TN.
ELECTRON EMISSION DURING MULTICHARGED ION-SURFACE INTERACTIONS
P. A. ZeijlmansvanEmmichoven (Tennessee Univ., Oak Ridge.), C. C. Havener, F. W. Meyer, and D. M. Zehner 1990 14 p Presented at the 11th International Conference on the Application of Accelerators in Research and Industry, Denton, MD, 5-8 Nov. 1990
(Contracts DE-AC05-84OR-21400; DE-FG05-87ER-40361)
(DE91-000615; CONF-901116-6) Avail: NTIS HC/MF A03

Recent measurements of electron spectra for slow multicharged N ion-surface collisions are presented. The emphasis is on potential emission, i.e., the electron emission related to the neutralization of the ions. When using N ions that carry a K shell vacancy into the collision, characteristic K Auger electron emission from the projectiles is observed, as well as, for specific surfaces, target atom Auger transitions (resulting from vacancy transfer). Measurements of the intensity of these Auger transitions as a function of the time the ions spend above the surface can serve as a useful probe of the timescales characterizing the relevant neutralization processes. This technique is elucidated with the help of some computer simulations. It is shown that neutralization timescales required in the atomic ladder picture, in which neutralization takes place by resonant capture followed by purely intra-atomic Auger transitions, are too long to explain our experimental results. The introduction of additional neutralization/de-excitation mechanisms in the simulations leads to much better agreement with the experiments. DOE

N91-13241# Rice Univ., Houston, TX. Dept. of Physics.
NUCLEAR STRUCTURE AT INTERMEDIATE ENERGIES Progress Report, 1 Jan. - 31 Dec. 1990
B. E. Bonner and G. S. Mutchler 30 Sep. 1990 71 p
(Contract DE-FG05-87ER-40309)
(DE91-000678; DOE/ER-40309/13) Avail: NTIS HC/MF A04

This paper discusses the following topics: antiproton nucleus interactions; strangeness production in heavy ion collisions; search for a J(exp PC) exotic hybrid meson; the SMC experiment; pion production in neutron-proton scattering; spin transfer measurements for elastic neutron-proton scattering; radiative muon capture (RMC) on hydrogen; radiative decays of low-lying hyperons; photoproduction of jets in nuclei; cylindrical multiplicity detector; MWPC detectors and electronics; lead glass array; cylindrical wire chamber; beam calorimeter; shower counter; and muon veto hodoscope. DOE

N91-13242# Georgia Inst. of Tech., Atlanta. School of Physics.
NUCLEAR STRUCTURE FROM RADIOACTIVE DECAY Annual Progress Report
J. L. Wood 30 Sep. 1990 15 p
(Contract DE-FG05-87ER-40330)
(DE91-000932; DOE/ER-40330/44) Avail: NTIS HC/MF A03

This report discusses the nuclear structure of the following

isotopes as a result of radioactive decays: neutron-deficient iridium isotopes; neutron-deficient platinum isotopes; neutron-deficient gold isotopes; neutron-deficient mercury isotopes; neutron-deficient thallium isotopes; neutron-deficient lead isotopes; neutron-deficient promethium isotopes; and neutron-deficient samarium isotopes.
DOE

N91-13243# Oak Ridge National Lab., TN.
ELECTRON CAPTURE BY MULTICHARGED IONS FROM HYDROGEN ATOMS AT eV ENERGIES
C. C. Havener, M. P. Nesnidal, M. R. Porter, and Ronald A. Phaneuf 1990 12 p Presented at the 11th International Conference on the Application of Accelerators in Research and Industry, Denton, OH, 5-8 Nov. 1990
(Contract DE-AC05-84OR-21400)
(DE91-001214; CONF-901116-15) Avail: NTIS HC/MF A03

To quantitatively study electron capture during collisions of multiply charged ions with neutral atoms at near-thermal energies, keV-energy multicharged ion beams are merged with ground-state beams of H or D atoms of chosen velocity such that collisions in the relative energy range 1 to 1000 eV/amu result. Recent data for O(3+), O(4+) + H(D) are presented and compared with theoretical predictions. Recently completed modifications to the apparatus are described that will provide a significant improvement in signal-to-background and angular collection. These improvements will allow measurements to be extended to lower energies, where effects due to the ion-induced dipole attraction may be evident.
DOE

N91-13244# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
QUARKONIUM PRODUCTION AT HERA
K. J. A. Abraham Feb. 1990 7 p Submitted for publication
(NIKHEF-H/90-4; ETN-90-98052) Avail: NTIS HC/MF A02

The production cross sections for two S wave vector quarkonia (gamma and J over psi) via photon-gluon fusion at HERA energies are calculated. Sizable cross sections are found even after the phase cuts needed to guarantee inelasticity are imposed. Once inelasticity cuts are imposed the J over psi cross section falls to 2.44 nb, while gamma production is assumed to be inelastic even in the absence of cuts. Given the experimental resolutions expected, production of J over psi from cascade decays of B mesons is not considered a serious background.
ESA

N91-13245# Technische Univ., Darmstadt (Germany, F.R.). Fachbereich Physik.
BAND STRUCTURE CALCULATION FOR HEAVY FERMION SYSTEMS Ph.D. Thesis [BANDSTRUKTURRECHNUNG FUER SCHWERE-FERMIONEN-SYSTEME]
Juergen Sticht Aug. 1990 157 p In GERMAN
(ETN-90-98176) Avail: NTIS HC/MF A08

The importance of band structure effects in the physics of heavy fermion systems is emphasized. Local Density Approximations (LDA) give only ground state properties, so that it is necessary to also take into consideration the elements of the multiparticle theory which are determined by the excitation spectrum. The elementary ferromagnetic metal Gd is chosen to show that localized conditions of state can be well described by LDA band structure calculation. In the Electron Spin Resonance (ESR) experiment, the condition of state are not directly measured, but only their effects on the conduction electron status density. The band structures of the heavy fermion systems CeCu2Si2 and CeAl3, as calculated with the scattering phase approximation, shows a very narrow band, whose width alpha scales with the parameter.
ESA

N91-13246# Technische Univ., Darmstadt (Germany, F.R.). Fachbereich Physik.
MODEL EXAMINATION OF THE SINGLE PARTICLE PROPERTIES OF HIGH CORRELATED ELECTRON SYSTEMS Ph.D. Thesis [MODELLUNTERSUCHUNG DER EINTEILCHENEIGENSCHAFTEN HOCHKORRELIERTER ELEKTRONENSYSTEME]
Thomas Pruschke 1989 164 p In GERMAN
(ETN-90-98177) Avail: NTIS HC/MF A08

By the Extension of the Non Crossing Approximation (ENCA), where U equals infinity for any value of the Coulomb interaction U, it was made possible to calculate the dynamics and thermodynamics of the model for the total field of the model parameter. The ENCA represents the currently most comprehensive approximation for a theoretical description of the behavior of magnetic lattice dispersion of compounds with lanthamides or actinides. The proposed extension of the Anderson model to an hybridization between of conditions and Ligand orbitals together with the ENCA for the deathnium center problem means a possible realistic description of the actinide HF systems. For further research in the field of electronic high correlated materials, these results represent, even if they are of a qualitative nature, a contribution to a deeper understanding of the microscopic properties of such systems.
ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N91-13247# Brookhaven National Lab., Upton, NY. Dept. of Physics.
OVERVIEW OF HIGH ENERGY PHYSICS WITH POLARIZED PARTICLES
Jacques Soffer Aug. 1990 14 p Presented at the International Conference on Polarization Phenomena in Nuclear Physics, Paris, France, 9-13 Jul. 1990 Submitted for publication
(Contract DE-AC02-76CH-00016)
(DE91-001119; BNL-45115; CONF-900726-3) Avail: NTIS HC/MF A03

The purpose of this talk is to review spin effects in various areas of particle physics at high energy and by selecting the most interesting topics, to show the relevance of dealing with polarized particles. We will see that it provides crucial tests for the Standard Model and can give us clear signatures to uncover new interactions. We will also discuss some striking experimental facts recently observed in hadronic collisions and their implications for current theoretical ideas.
DOE

74 OPTICS

Includes light phenomena; and optical devices.

For lasers see *36 Lasers and Masers.*

N91-13248# Army Missile Command, Redstone Arsenal, AL. Directed Energy Directorate.
MINILINK II: PROTOTYPE OF A MINIATURE SELF-CALIBRATING FIBER OPTIC ANALOG DATA LINK Final Technical Report, Jul. - Dec. 1989
J. D. Holder Jun. 1990 22 p
(AD-A224995; AD-E951509; AMSMI/TR-RD-DE-90-1) Avail: NTIS HC/MF A03 CSCL 20/6

The purpose of developing a fiber optic analog data link is to make possible the monitoring of test article function during the exposure of that article to severe environmental conditions. The use of fiber optics to transmit the signal monitored yields immunity to electromagnetic interference (EMI) and similar potential sources of measurement interference. This report details the design and performance of a proof-of-principle prototype of such a system. The system consists of an Analog Board, a Digital Board, and a Power Assembly. The function of the Analog Board is to monitor the test point. The Digital Board is to perform automatic setting of the bias point of the fiber optic transmitter and to control the above signal switching so that automatic calibration may be achieved.
Author (GRA)

N91-13249# ARC Professional Service Group, Inc., Rockville, MD.
AN/AIC-22(V) INTERCOMMUNICATIONS SET (ICS) FIBER OPTIC LINK ENGINEERING ANALYSIS REPORT Final Report, period ending 12 Oct. 1989
Richard Minter, Roland Blocksom, and Christopher Ling Aug. 1990 50 p
(Contract N00014-90-C-2033)
(AD-A225830; TR-2917) Avail: NTIS HC/MF A03 CSCL 20/6

Electromagnetic interference (EMI) problems constitute a serious threat to operational Navy aircraft systems. The application of fiber optic technology is a potential solution to these problems. EMI reported problems in the P-3 patrol aircraft AN/AIC-22(V) Intercommunications System (ICS) were selected from an EMI problem database for investigation and possible application of fiber optic technology. A proof-of-concept experiment was performed to demonstrate the level of EMI immunity of fiber optics when used in an ICS. A full duplex single channel fiber optic audio link was designed and assembled from modified government furnished equipment (GFE) previously used in another Navy fiber optic application. The link was taken to the Naval Air Test Center (NATC) Patuxent River, Maryland and temporarily installed in a Naval Research Laboratory (NRL) P-3A aircraft for a side-by-side comparison test with the installed ICS. With regards to noise reduction, the fiber optic link provided a qualitative improvement over the conventional ICS. In an effort to obtain a quantitative measure of comparison, audio frequency range both with and without operation of the aircraft VHF and UHF radio transmitters. GRA

N91-13250# Tufts Univ., Medford, MA. Electro-Optics Technology Center.
PHASE TECHNIQUES FOR IMAGING AND RECOGNITION Final Technical Report, Jul. 1988 - Sep. 1989
Robert A. Gonsalves May 1990 51 p
(Contract F30602-88-D-0027; AF Proj. 2305)
(AD-A226233; RADC-TR-90-61) Avail: NTIS HC/MF A04 CSCL 20/6

Research is described on two aspects of phase manipulation in optical processing. Phase diversity uses multiple observations of image, where the optical system is changed in a known fashion between observations. The images are processed to remove the effects of unknown phase degradations. We also study binary phase-only filtering and find that the binarization can be done in a phase-rotated space which gives rise to improved object recognition. One-dimensional example of both techniques are given. GRA

N91-13251# Lowell Univ., MA. Dept. of Chemistry.
A STRATEGY FOR THE DEVELOPMENT OF MACROMOLECULAR NONLINEAR OPTICAL MATERIALS
Braja K. Mandal, Jan-Chan Huang, Jayant Kumar, and Sukant Tripathy 1990 13 p
(Contract N00014-90-J-1148)
(AD-A226325; TR-9) Avail: NTIS HC/MF A03 CSCL 07/6

Three convenient techniques to process second order organic nonlinear optical materials have been emphasized. Active moieties suffer from slow relaxation of the field-induced noncentrosymmetric alignment when processed with amorphous polymers or grafted to a flexible polymer backbone. Novel approaches to assemble the active molecules in preferred orientations in epoxy and phenol-formaldehyde resins are presented. GRA

N91-13252# Maryland Univ., Baltimore. Dept. of Electrical Engineering.
PULSE PROPAGATION IN INHOMOGENEOUS OPTICAL FIBERS Progress Report, 15 Sep. 1989 - 14 Sep. 1990
Curtis R. Menyuk 19 Sep. 1990 6 p
(Contract DE-FG05-89ER-14090)
(DE91-000821; DOE/ER-14090/1) Avail: NTIS HC/MF A02

This paper discusses research at the University of Maryland on optical fiber switches and the propagation of solitons through the optical fibers. The major areas covered include: the solid state devices; soliton switch using birefringent optical fibers; soliton evolution and interaction in optical fibers with randomly varying birefringence; and using Hamiltonian techniques to derive the basic equations describing birefringent fibers and some simple fiber properties. DOE

N91-13253# Brookhaven National Lab., Upton, NY.
IN SEARCH OF THE ELUSIVE TRUE SURFACE
Peter Z. Takacs, Karen Furenlid, and Eugene L. Church (Army Armament Research and Development Command, Dover, NJ.) Aug. 1990 15 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract DE-AC02-76CH-00016)
(DE91-001110; BNL-45153; CONF-900756-51) Avail: NTIS HC/MF A03

Measurement of an optical surface by a figure measuring device allows one to make an estimate of the shape of the surface. The absolute accuracy in locating the true surface depends on the sources of error in the measurement process -- both random errors and systematic errors. Analysis procedures have been developed to extract surface figure information from optical profiler measurements on large mirrors. Rigid-body orientation effects are important in analyzing the shape of the off-axis ellipsoidal reflectors used as gazing incidence mirrors in soft-ray synchrotron instrumentation. Knowledge of the noise level and optical aberration function of the Long Trace Profiler allow us to place error bars smaller than lambda/100 on measurements of surfaces that are more than 500 mm long. DOE

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N91-13254# Texas Univ., Austin. Inst. for Fusion Studies.
EFFECTS OF COMPRESSIBILITY, DIAMAGNETIC DRIFT, AND THERMAL CONDUCTION ON RESISTIVE BALLOONING MODES IN THE SECOND STABILITY REGIME
Jin-Yong Kim, D. I. Choi (Korea Advanced Inst. of Science and Technology, Seoul, Republic of Korea), J. W. VanDam, and W. Horton Aug. 1990 23 p
(Contract DE-FG05-80ET-53088)
(DE90-017618; DOE/ET-53088/451; IFSR-451) Avail: NTIS HC/MF A03

The stabilizing effects of various terms such as compressibility, diamagnetic drift, and parallel thermal conduction are investigated on the type of resistive ballooning modes whose driving force comes from the resistive region, which are known to be unstable in the high-beta second stability regime when analyzed in the incompressible limit. It is found that compressibility gives a significant stabilizing effect mainly through the perpendicular magnetic compression, which suggests the possibility of a second stable window for these resistive ballooning modes. The diamagnetic drift terms slightly reduce the growth rate in the incompressible limit, but, with finite compressibility, lead to fairly strong stabilization. The compression due to ion polarization, which becomes significant at large diamagnetic drift, contributes to this stabilization. On the other hand, parallel thermal conduction and perpendicular magnetic compression, which enter through the equation for temperature evolution, are shown to have a negligible effect on the stability of these modes. DOE

N91-13255# National Inst. for Fusion Science, Nagoya (Japan).
AN EMPIRICAL SCALING OF THE THERMAL DIFFUSIVITY APPLICABLE TO BOTH L- AND H-MODE DISCHARGES
N. Ohyabu Feb. 1990 15 p Submitted for publication
(DE90-520194; NIFS-15) Avail: NTIS (US Sales Only) HC A03

An empirical scaling of the thermal diffusivity has been constructed which fits well with most of the key observations of

steady-state heat transport in tokamaks. This scaling also agrees with observed dynamical transport phenomena and suggests interesting future experiments. DOE

N91-13256# National Inst. for Fusion Science, Nagoya (Japan).
CURRENT BUBBLE FORMATION BY NONLINEAR COUPLING OF RESISTIVE TEARING MODES
Kazuhiro Urata, Tadatsugu Hatori, and Tsuneo Amano Feb. 1990 15 p Submitted for publication
(DE90-520195; NIFS-14) Avail: NTIS (US Sales Only) HC A03

The current bubble means a helical duct with low current density invading the inner high current region of current carrying toroidal plasmas. It is a non-turbulent analogue of the MHD clump. The numerical simulations show that it appears right after the absorption of a small magnetic island into the chaotic layer in the separatrix region of a large magnetic island. DOE

N91-13257# National Inst. for Fusion Science, Nagoya (Japan).
EFFECT OF CONFINEMENT OF SoL PLASMA ON CORE TEMPERATURE PROFILE
K. Itoh and S.-I. Itoh Feb. 1990 11 p Submitted for publication Sponsored in part by Fusion Research of MoE Japan
(DE90-520198; NIFS-11) Avail: NTIS (US Sales Only) HC A03

The dependence of the core confinement on the edge plasma parameter is discussed in L-mode tokamaks. Employing the result of the transport analysis in the scrape-off layer, the boundary condition for the transport in the core plasma is expressed in terms of the heating power. Various forms of the dependences of local thermal conductivity on the temperature and temperature gradient are examined. The power dependence of the edge temperature is found to be an origin of the profile resiliency holds in a wide range of the heating power in L-mode tokamaks. DOE

N91-13258# National Inst. for Fusion Science, Nagoya (Japan).
ADIABATIC INVARIANT AND EVALUATION OF PARTICLE LOSS IN HELICAL TORUS
Jiro Todoroki Feb. 1990 41 p Submitted for publication Sponsored in part by Fusion Research of Ministry of Education, Science, and Culture
(DE90-520199; NIFS-10) Avail: NTIS (US Sales Only) HC A03

Analytic expression for the longitudinal adiabatic invariant is derived for general magnetic configuration. The orbit loss is evaluated to determine the outermost loss-free surface. Geometrical factor of the neoclassical transport coefficients in 1/nu regime in helical torus is calculated by using the longitudinal adiabatic invariant. The dependence of the particle confinement upon the geometrical parameter is investigated for N = 10 configurations; and the improvement by the inward shift of the magnetic axis is quantitatively clarified. DOE

N91-13259# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
MATERIALS SELECTION AND STRUCTURES FOR PLASMA ACCELERATORS IN ELECTROTHERMAL GUNS
Frantz-Peter Kilian, Horst Kirsche, and Hans O. Leis 1990 5 p Presented at 5th Symposium on Electromagnetic Launch Technology, Sandestin, FL, 2-5 Apr. 1990 Sponsored by BMFT
(MBB-Z-0303-90-PUB; ETN-90-97881) Copyright Avail: NTIS HC/MF A01

Failure analysis from initial experiments using low energy input show which materials and structural designs are best suited for the development of plasmaburners in a plasma accelerator system. Melting problems on the surface of the electrodes have not been solved. The use of ceramic liners instead of plastic insulators resulted in difficulties in connection with the glass fiber reinforced plastic cylinder, which is due to the fact that the differences in Young's moduli between the two materials are considerable. A cartridge is introduced in which the plasma material in the form of solid or liquid is fixed. The cartridge should be replaced after every shot. In designing the plasmaburner, such parameters as a high degree of mechanical resistivity, no concentration of the electric field as well as sufficient electrical insulation must all be taken into account. ESA

N91-13260# Los Alamos National Lab., NM.
ZTI: AN IGNITION CLASS REVERSED-FIELD PINCH
C. G. Bathke, R. A. Krakowski, R. L. Miller, and K. A. Werley 1990 6 p Presented at the 16th Symposium on Fusion Technology, London, England, 3-7 Sep. 1990
(Contract W-7405-eng-36)
(DE91-000447; LA-UR-90-2938; CONF-900918-9) Avail: NTIS HC/MF A02

A cost-optimized conceptual design of an intermediate-step, ignition-class RFP device (ZTI) for the study of alpha-particle physics and burn control in a DT plasma is reported. With major and minor plasma radii R(sub T) = 2.4m and tau(sub p) = 0.4 m, respectively, and for conservative extrapolations of experimental energy-confinement times, ion-density profiles, and impurity levels, the ZTI operating conditions during a 5-s period of constant fusion power are: toroidal plasma current I(sub phi) is approximately equal to 9 MA, plasma temperature T is approximately equal to 11 keV, plasma density n(sub i) is approximately equal to 3 x 10(exp 20)/cu m, fusion power P(sub F) is approximately equal to 100 MW, and physics Q-value Q(sub p) is approximately equal to 5 for a total machine size that corresponds to P(sub F)/M(sub FPC) is approximately equal to 590 kW/tonne. This physics design point was adopted as a strawman with which to examine the requirements of ohmic heating to DT ignition and to perform a cost-optimized magnetics design. The ZTI design reflects potentially significant cost savings relative to similar ignition-class tokamaks for device parameters that reside on the path to a viable commercial RFP reactor. The methodology and results of coupling realistic physics, engineering, and cost models through a multi-dimensional optimizer are reported for this device that would follow the 2 to 4 MA ZTH presently under construction. DOE

N91-13261# Oak Ridge National Lab., TN.
FAST-WAVE CURRENT DRIVE MODELLING FOR LARGE NON-CIRCULAR TOKAMAKS
D. B. Batchelor, R. C. Goldfinger, E. F. Jaeger, M. D. Carter, D. W. Swain, D. Ehst, and C. F. F. Karney (Princeton Univ., NJ.) 1990 5 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, DC, 1-6 Oct. 1990 Submitted for publication
(Contract DE-AC05-84OR-21400)
(DE91-000562; IAEA-CN-53/E-3-11; CONF-901025-9) Avail: NTIS HC/MF A01

It is widely recognized that a key element in the development of an attractive tokamak reactor, and in the successful achievement of the mission of ITER, is the development of an efficient steady-state current drive technique. Fast waves in the ion cyclotron range of frequencies hold the promise to drive steady-state currents with the required efficiency and to effectively heat the plasma to ignition. Advantages over other heating and current drive techniques include low cost per watt and the ability to penetrate to the center of high-density plasmas. The primary issues that must be resolved are: the design of an antenna array can radiate the required spectrum of waves and have adequate coupling properties; effective absorption of RF power by electrons in the desired velocity range without unacceptable parasitic damping by fuel ions or alpha particles; the efficiency of current drive when toroidal effects such as trapped particles are included; and the design and integration of a practical RF system into the device. These issues were addressed by performing extensive calculations with ORION, a 2-D code, and the ray tracing code RAYS, which calculate wave propagation, absorption and current drive in tokamak geometry, and with RIP, a 2-D code that self-consistently calculates current drive with MHD equilibrium. An important figure of merit in this context is the integrated, normalized current drive efficiency. The calculations presented here emphasize the ITER device. A low-frequency scenario is considered such that no ion resonances appear in the machine, and a high-frequency scenario such that the deuterium second harmonic resonance is just outside the plasma and the tritium second harmonic is in the plasma,

midway between the magnetic axis and the inside edge. In both cases electron currents are driven by combined TTMP and Landau damping of the fast waves. DOE

N91-13262# Michigan Univ., Ann Arbor.
MICROWAVE EXCITATION OF COPPER VAPOR PLASMAS Final Report
Mary L. Brake 1990 68 p Prepared for Lawrence Livermore National Lab., CA
(Contract W-7405-eng-48)
(DE91-000588; UCRL-CR-104873) Avail: NTIS HC/MF A04

Microwave resonant cavity produced copper vapor plasmas at 2.45 GHz, both pulsed (5 kW, 5 kHz,) and CW (0 to 500 Watts) were investigated using heated copper chloride as the copper source. The visible emitted light was observed and intense lines at 510.6 nm and 578.2 nm were also observed. Initial measurements of the electric field strengths were taken with probes, the plasma volume was measured with optical techniques, and the power was measured with power meters. A self-consistent electromagnetic model of the cavity/plasma systems which uses the above data as input shows that the copper plasma has skin depths around 100 cm, densities around 10(exp 12) (number sign)/cc, collisional frequencies around 10(exp 11)/sec, and conductivities around 0.15/(Ohm-meter). A simple model of the heat transfer predicts temperatures of approximately 800 K. All of these parameters indicate that microwave discharges may be well suited as a pump source for copper lasers. DOE

N91-13263# Tennessee Univ., Tullahoma. Space Inst.
POTENTIAL APPLICATION OF MAGNETOHYDRODYNAMIC ACCELERATION TO HYPERSONIC ENVIRONMENTAL TESTING Final Report, 1 Mar. 1988 - 31 Dec. 1989
R. A. Crawford, J. N. Chapman, and R. P. Rhodes Aug. 1990 99 p Prepared in cooperation with Arnold Engineering Development Center, Arnold Air Force Station, TN
(AD-A225678; AEDC-TR-90-6) Avail: NTIS HC/MF A05 CSCL 20/9

This investigation reviews the technical results from previous MHD accelerator research and conducts a theoretical analysis of the simulation capabilities of an MHD-augmented hypersonic flow facility. This investigation identified the performance potential of MHD accelerator and hot gas generator combinations subject to reasonable constraints from available technology. The performance goal was to extend the hypersonic flight simulation limits from Mach 10 to Mach 25. The results of this investigation identified the critical technology issues which must be addressed in the design of an MHD-driven hypersonic test facility. GRA

N91-13264# Lawrence Livermore National Lab., CA.
SOFT X RAY DETECTION WITH DIAMOND PHOTOCONDUCTIVE DETECTORS
D. R. Kania, L. Pan, H. Kornblum, P. Bell, O. N. Landen, and P. Pianetta May 1990 9 p Presented at the 8th Topical Conference on High-Temperature Plasma Diagnostics, Hyannis, MA, 6-10 May 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE91-000418; UCRL-JC-103883; CONF-900557-14) Avail: NTIS HC/MF A02

Photoconductive detectors fabricated from natural IIa diamonds have been used to measure the x ray power emitted from laser produced plasmas. The detector was operated without any absorbing filters to distort the x ray power measurement. The 5.5 eV bandgap of the detector material practically eliminates its sensitivity to scattered laser radiation thus permitting filterless operation. The detector response time or carrier life time was 90 ps. Excellent agreement was achieved between a diamond PCD and a multichannel photoemissive diode array in the measurement of radiated x ray power and energy. DOE

N91-13265# Lawrence Livermore National Lab., CA.
COMMENTS ON OPEN-ENDED MAGNETIC SYSTEMS FOR FUSION
Richard F. Post 24 Sep. 1990 25 p Presented at the Workshop on Physics of Alternative Magnetic Confinement Schemes, Varenna, Italy, 14-15 Oct. 1990
(Contract W-7405-eng-48)
(DE91-000972; UCRL-JC-105056; CONF-9010209-2) Avail: NTIS HC/MF A03

Differentiating characteristics of magnetic confinement systems having externally generated magnetic fields that are open are listed and discussed in the light of their several potential advantages for fusion power systems. It is pointed out that at this stage of fusion research high-Q (as deduced from long energy confinement times) is not necessarily the most relevant criterion by which to judge the potential of alternate fusion approaches for the economic generation of fusion power. An example is given of a hypothetical open-geometry fusion power system where low-Q operation is essential to meeting one of its main objectives (low neutron power flux). DOE

N91-13266# Sandia National Labs., Albuquerque, NM.
INERTIAL CONFINEMENT FUSION WITH LIGHT ION BEAMS
J. P. Vandevender, R. G. Adams, G. O. Allshouse, J. E. Bailey, K. W. Beig, D. D. Bloomquist, R. S. Coats, D. L. Cook, G. E. Chandler, and M. E. Cuneo et al 1990 10 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, DC, 1-6 Oct. 1990
(Contract DE-AC04-76DP-00789)
(DE91-001224; SAND-90-0968C; CONF-901025-11; IAEA-CN-53/B-1-1) Avail: NTIS HC/MF A02

Advances are reported in the theory and experiments investigating Inertial Confinement Fusion with light ion beams on the Particle Beam Fusion Accelerator II (PBFA II). Impedance of the accelerating gap, electron-ion instabilities, proton beam generation and focusing at 300 kJ, proton driven target experiments to measure beam non-uniformity, lithium beam generation and focusing at 185 kJ, and plasma opening switch improvements for voltage and power gain are reported. DOE

N91-13267# Lawrence Livermore National Lab., CA.
FUSION ENERGY
Sep. 1990 6 p Presented at the American Nuclear Society Annual Meeting, Nashville, TN, 10-14 Jun. 1990
(Contract W-7405-eng-48)
(DE91-000801; UCRL-JC-104849; CONF-900608-Absts) Avail: NTIS HC/MF A02

The main purpose of the International Thermonuclear Experimental Reactor (ITER) is to develop an experimental fusion reactor through the united efforts of many technologically advanced countries. The ITER terms of reference, issued jointly by the European Community, Japan, the USSR, and the United States, call for an integrated international design activity and constitute the basis of current activities. Joint work on ITER is carried out under the auspices of the International Atomic Energy Agency (IAEA), according to the terms of quadripartite agreement reached between the European Community, Japan, the USSR, and the United States. The site for joint technical work sessions is at the Max Planck Institute of Plasma Physics. Garching, Federal Republic of Germany. The ITER activities have two phases: a definition phase performed in 1988 and the present design phase (1989 to 1990). During the definition phase, a set of ITER technical characteristics and supporting research and development (R and D) activities were developed and reported. The present conceptual design phase of ITER lasts until the end of 1990. The objectives of this phase are to develop the design of ITER, perform a safety and environmental analysis, develop site requirements, define future R and D needs, and estimate cost, manpower, and schedule for construction and operation. A final report will be submitted at the end of 1990. This paper summarizes progress in the ITER program during the 1989 design phase. DOE

N91-13268# Lawrence Livermore National Lab., CA.
GRAZING INCIDENCE METAL MIRRORS AS THE FINAL ELEMENTS IN A LASER DRIVER FOR INERTIAL CONFINEMENT FUSION
Robert L. Bieri and Michael W. Guinan Oct. 1990 18 p

Presented at the 9th Topical Meeting on Technology of Fusion Energy, Oak Brook, IL, 7-11 Oct. 1990
(Contract W-7405-eng-48)
(DE91-000944; UCRL-JC-103817; CONF-901007-9) Avail: NTIS HC/MF A03

Grazing incidence metal mirrors (GIMMS) have been examined to replace dielectric mirrors for the final elements in a laser beam line for an inertial confinement fusion (ICF) reactor. For a laser driver using light with a wavelength from 250 to 500 nm in a 10 ns pulse, irradiated mirrors made of Al, Al alloys, or Mg were found to have calculated laser damage limits of 0.3 to 2.3 J/cm(sup 2) of beam energy and neutron lifetime fluence limits of over 5 x 10(sup 20) neutrons per square centimeter when use at grazing incidence (an angle of incidence of 85 degrees) and operated at room temperature or at 77 K. A final focusing system including mirrors made of Al alloy 7475 at room temperature or at liquid nitrogen (LN) temperatures used with a driver which delivers 5 MJ of beam energy in 32 beams would require 32 mirrors of roughly 10 m(sup 2) each. This paper briefly reviews the methods used in calculating the damage limits for GIMMs and discusses critical issues relevant to the integrity and lifetime of such mirrors in a reactor environment. DOE

N91-13269# Lawrence Livermore National Lab., CA.
K-SHELL AND L-SHELL PLASMA SPECTROSCOPY EXPERIMENTS
G. Charatis (KMS Fusion, Inc., Ann Arbor, MI.) Oct. 1990 9 p
(Contract W-7405-eng-48)
(DE91-000950; UCRL-CR-106064) Avail: NTIS HC/MF A02

Detailed atomic level populations in high temperature and dense plasmas have become increasingly important in laser generated plasmas. Certain spectral line intensity ratios are density-dependent while others are temperature-dependent. Both can be used to extract information concerning population kinetics and ion level populations. In order to be useful these dependencies must be characterized by independent means. In laser produced plasmas this can be done via holographic interferometry for electron density determinations and via the slope of the H-like free-bound continuum of K-shell lines for electron temperature determinations. The characterization of density- and temperature-dependent L-shell lines can be accomplished in ionization balance experiments in which laser irradiance is varied on targets which contain both K-shell and L-shell emitters. The K-shell free-bound continua provide the local temperature determination while holographic interferometry yields density profile information, from which the temperature and density dependent L-shell lines can be characterized. This paper discusses these concepts. DOE

N91-13270# Lawrence Livermore National Lab., CA.
SOME APPLICATIONS OF MIRROR-GENERATED ELECTRIC POTENTIALS TO ALTERNATIVE FUSION CONCEPTS
Richard F. Post 24 Sep. 1990 21 p Presented at the Workshop on Physics of Alternative Magnetic Confinement Schemes, Varenna, Italy, 15-24 Oct. 1990
(Contract W-7405-eng-48)
(DE91-000973; UCRL-JC-104182; CONF-9010209-1) Avail: NTIS HC/MF A03

Transient electrical potentials can be generated in plasmas by utilizing impulsive mirror-generated forces acting on the plasma electrons together with ion inertia to cause momentary charge imbalance. In the Mirrortron such potentials are generated by applying a rapidly rising (tens of nanoseconds) localized mirror field to the central region of a hot-electron plasma confined between static mirrors. Because of the loss-cone nature of the electron distribution the sudden appearance of the pulsed mirror tends to expel electrons, whereas the ion density remains nearly constant. The quasi-neutrality condition then operates to create an electrical potential the equipotential surfaces of which can be shown theoretically to be congruent with surfaces of constant B. An alternative way of generating transient potentials is to apply a pulse of high-power microwaves to a plasma residing on a magnetic field with a longitudinal gradient. This technique resembles one employed in the Pleiade experiments. At gigawatt power levels, such as those produced by a Free Electron Laser, the production of very high transient potentials is predicted. Fusion-relevant applications of these ideas include heavy-ion drivers for inertial fusion, and the possibility of employing these techniques to enhance the longitudinal confinement of fusion plasmas in multiple-mirror systems. DOE

N91-13271# Naval Research Lab., Washington, DC. Space Plasma Branch.
PLASMA INSTABILITIES IN THE HIGH AND LOW LATITUDE E-REGION INDUCED BY HIGH POWER RADIO WAVES Interim Report
P. K. Chaturvedi and S. L. Ossakow 14 Sep. 1990 38 p Sponsored by ONR, Arlington, VA
(AD-A226617; NRL-MR-6712) Avail: NTIS HC/MF A03 CSCL 04/1

The effect of a high frequency (HF) powerful pump wave on high and low latitude E-region low frequency plasma instabilities is theoretically considered. The growth rates and threshold criteria are calculated for the electrojet associated (Farley-Buneman, gradient drift) and higher altitude high latitude parallel current associated (ion-acoustic, ion cyclotron, current convective) instabilities. The results are discussed in the context of present ionospheric modification (heating) experiments, for the high and low latitude ionosphere. GRA

N91-13272# Cornell Univ., Ithaca, NY. Lab. of Plasma Studies.
PLASMA PHYSICS APPLICATIONS TO INTENSE RADIATION SOURCES, PULSED POWER, AND SPACE PHYSICS Final Report, 1 Jan. - 31 Dec. 1989
David A. Hammer 12 Sep. 1990 37 p
(Contract N00014-89-J-2009)
(AD-A226666; LPS-90-17) Avail: NTIS HC/MF A03 CSCL 20/9

The status of research tasks are presented including descriptions of results from experiments on the X-Pinch as a pump source for short wavelength photopumped lasers, long conduction time Plasma Opening Switch research, both experimental and theoretical, and a brief description of experiments initiated on the use of electrooptical diagnostics to study the plasma produced by NRL flashboards (commonly used in opening switch experiments). GRA

N91-13273# Technische Univ., Brunswick (Germany, F.R.). Fakultaer fuer Maschinenbau und Elektrotechnik.
REAL TIME CLASSIFICATION OF IONS IN SPACE Ph.D. Thesis [ECHTZEITKLASSIFIKATION VON IONEN IM WELTRAUM]
Wolfgang Rieck 1990 207 p In GERMAN
(ETN-90-98195) Avail: NTIS HC/MF A10

For the analysis of plasma flows in space, ion spectrometers were used, which carried out a classification an ion population, on the basis of individual particule measured values. With the Solar Wind Ion Composition Spectrometer (SWICS), the measured principles and the functional units of an ion spectrometer used in space were presented. Using a sensor model, the relationship between the characteristics of an ion and the measured values given by the sensor, was described. The classification, e.g., the correspondance of a particle individual measured data record to a determined ion class was represented in a classification model. The ion classification was carried out by the digital ion classifier, composed of three classifier (mass-load, mass and counting channel, and priority classifier). The comparison of the classification processes showed that a classifier with a one-dimensional descriptor, for instance the mass-load classifier, is the best for realizing a complete chart. For a two-dimensional descriptor, the decision depends in general on the boundary conditions given by the mission. ESA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N91-13274# Office of Technology Assessment, Washington, DC.
HIGH-TEMPERATURE SUPERCONDUCTIVITY IN PERSPECTIVE
Apr. 1990 138 p
(PB90-253790; OTA-E-440) Avail: NTIS HC/MF A07; also available SOD HC $6.50 as 052-003-01187-5 CSCL 20L

The technology of superconductivity and its potential applications are discussed; it is warned that U.S companies are investing less than their main foreign competitors in both low- and high-temperature superconductivity R and D. This is by far the most critical issue affecting the future U.S. competitive position in superconductivity, and in many other emerging technologies. The major areas covered include: Executive summary; High-temperature superconductivity - A progress report; Applications of superconductivity; The U.S. response to high-temperature superconductivity; High-temperature superconductivity programs in other countries; Comparison of industrial superconductivity R and D efforts in the United States and Japan - An OTA survey; Policy issues and options. GRA

N91-13275# Diamond Materials, Inc., Burlington, MA.
SYNTHESIS OF LARGE AREA, MONOCRYSTALLINE TiC AS A SUBSTRATE FOR HETEROEPITAXIAL GROWTH OF BETA-SiC Final Report, 7 Sep. 1989 - 30 Jun. 1990
Richard Koba 23 Jul. 1990 29 p
(Contract N00014-89-C-0208)
(AD-A225159) Avail: NTIS HC/MF A03 CSCL 20/2

The purpose of this program was to investigate an alternative method of synthesizing large area TiC monocrystals by a procedure involving multiple chemical vapor deposition (CVD) steps. The proposed method consisted of (1) heteroepitaxial growth of beta-SiC on Si by CVD, (2) gettering of defects in the beta-SiC, and (3) heteroepitaxial growth of TiC on beta-SiC by CVD. Because of numerous technical difficulties, DMI's effort was limited to CVD of beta-SiC on Si. DMI developed a process to etch Si and deposit beta-SiC on Si at a constant temperature of 1300 C without cycling the temperature between etching step and CVD step. Beta-sic was grown using methyltrichlorosilane (CH3SiCl3) without prior carburizing the Si surface. The microstructure of the deposited Beta-SiC film evolved from highly oriented cubic subgrains which coalesced into a smooth, continuous film. GRA

N91-13276# Arizona State Univ., Tempe. Dept. of Physics.
THEORY OF ELECTRONIC STATES AND FORMATION ENERGIES OF DEFECT COMPLEXES, INTERSTITIAL DEFECTS, AND CRYSTAL GROWTH IN SEMICONDUCTORS Final Technical Report
Otto F. Sankey 1989 17 p
(Contract N00014-85-K-0042)
(AD-A225674) Avail: NTIS HC/MF A03 CSCL 20/12

Briefly summarized is all the work that has been performed in this final report. The major accomplishments were: (1) the determination of trends in defect concentration in III-V and II-VI semiconductors, and (2) the development and deployment of a novel quantum molecular dynamics method which is far faster and can handle larger systems than any competing method. These topics will be marked with a **** to indicate their importance. The topics are: (1) Deep electronic levels of large chalcogenide defect complexes in Si, (2) Atomic forces from electronic energies via the Hellmann-Feynman theorem with application to semiconductor (110) surface relaxation, (3) Theoretical modeling of solid hydrogen halides under pressure, (4) An abitio self-consistent tight-binding model for semiconductors, (5) The prediction of near edge structure in electron energy loss experiments using the ab-initio model of section (4), ****(6) The prediction of equilibrium defect concentrations in II-VI and III-V semiconductor materials, and ****(7) An efficient method for performing quantum molecular dynamics calculation in covalent systems. GRA

N91-13277# PCO, Inc., Chatsworth, CA.
THE GROWTH OF EPITAXIAL GaAs AND GaAlAs ON SILICON SUBSTRATE BY MOVPE Final Report, Sep. 1986 - Sep. 1989
R. R. Bradley, J. A. Beswick, P. Kightley, D. J. Stirland, and D. J. Warner Mar. 1990 36 p
(Contract N00014-86-C-2432)
(AD-A225743) Avail: NTIS HC/MF A03 CSCL 07/2

The objectives were to undertake research into the growth of GaAs and AlGaAs on silicon substrates, to refine deposition techniques, and optimise the electrical, optical, and structural properties of the layers; to prepare GaAs/AlGaAs heterostructures on silicon for opto-electronic and microwave devices; and to explore the monolithic integration of III-V devices on silicon CMOS ICs. Substantial achievements were made within the area of materials growth, resulting in the development of a successful process for the MOVPE growth of GaAs onto silicon excellent device results. Device and materials growth achievements are outlined. GRA

N91-13278*# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
INVESTIGATION OF NEW SEMIINSULATING BEHAVIOR OF III-V COMPOUNDS Final Technical Report, 16 Aug. 1988 - 23 Feb. 1990
Jacek Lagowski 23 Feb. 1990 50 p Sponsored by NASA, Washington, DC
(Grant AF-AFOSR-0342-86; AF Proj. 2306)
(NASA-CR-187682; NAS 1.26:187682; AD-A225762; AFOSR-90-0872TR) Avail: NTIS HC/MF A03 CSCL 09/1

The investigation of defect interactions and properties related to semiinsulating behavior of III-V semiconductors resulted in about twenty original publications, six doctoral thesis, one masters thesis and numerous conference presentations. The studies of new compensation mechanisms involving transition metal impurities have defined direct effects associated with deep donor/acceptor levels acting as compensating centers. Electrical and optical properties of vanadium and titanium levels were determined in GaAs, InP and also in ternary compounds InGaAs. The experimental data provided basis for the verification of chemical trends and the VRBE method. They also defined compositional range for III-V mixed crystals whereby semiinsulating behavior can be achieved using transition elements deep levels and a suitable codoping with shallow donor/acceptor impurities. GRA

N91-13279*# Massachusetts Inst. of Tech., Lexington. Solid State Div.
SOLID STATE RESEARCH Quarterly Technical Report, 1 Aug. - 31 Oct. 1989
Alan L. McWhorter 15 Nov. 1989 112 p Sponsored by NASA, Washington; Army; DARPA; Navy; Strategic Defense Initiative Organization; and DOE
(Contract F19628-90-C-0002)
(NASA-CR-187654; NAS 1.26:187654; AD-A225803; Rept-1989; Rept-4; ESD-TR-89-293) Avail: NTIS HC/MF A06 CSCL 20/12

This report details the research of the Solid State Division at Lincoln Laboratory for the period 1 August through 31 October 1989. The topics covered are Electrooptical Devices, Quantum Electronics, Materials Research, Submicrometer Technology, Microelectronics, and Analog Device Technology. GRA

N91-13280# Texas Instruments, Inc., Dallas.
QUANTUM DEVICE DEVELOPMENT Final Technical Report, 4 Sep. 1987 - 30 Jun. 1990
W. R. Frensley, J. H. Luscombe, J. N. Randall, M. A. Reed, A. Seabaugh, C. H. Yang, S. K. Diamond, and D. M. Bloom (Stanford Univ., CA.) 20 Jul. 1990 188 p
(Contract N00014-87-C-0363)
(AD-A225813; TI-08-90-36) Avail: NTIS HC/MF A09 CSCL 20/10

A research and development program on quantum transistors is described. Bipolar and unipolar resonant tunneling transistors were designed, fabricated, and characterized. These devices exhibit negative transconductance, and dc and microwave gain at room temperature. Recommendations are made for further work. GRA

N91-13281# Ceramic Process Systems Corp., Milford, MA.
COMPOSITE CERAMIC SUPERCONDUCTING WIRES FOR ELECTRIC MOTOR APPLICATIONS Annual Report No. 2, 1 Jul. 1989 - 30 Jun. 1990
John W. Halloran 30 Jul. 1990 153 p
(Contract N00014-88-C-0512)
(AD-A225859; CPS-90-020) Avail: NTIS HC/MF A08 CSCL 20/3

Several types of HTSC wire have been produced and two types of HTSC motors are being built. Hundreds of meters of Ag-clad wire were fabricated from YBa2Cu3O(7-x) (Y-123) and Bi2Ca2Sr2Cu3O10 (BiSCCO). The dc homopolar motor coils are not yet completed, but multiple turns of wire have been wound on the coil bobbins to characterize the superconducting properties of coiled wire. Multifilamentary conductors were fabricated as cables and coils. The sintered polycrystalline wire has self-field critical current densities (Jc) as high as 2800 A/sq cm, but the Jc falls rapidly with magnetic field. To improve Jc, sintered YBCO wire is melt textured with a continuous process which has produced textures wire up to 0.5 meters long with 77K transport Jc above 11, 770 A/sq cm2 in self field and 2100 A/sq cm2 at 1 telsa. The Emerson Electric dc homopolar HTSC motor has been fabricated and run with conventional copper coils. A novel class of potential very powerful superconducting motors have been designed to use trapped flux in melt textures Y-123 as magnet replicas in an new type of permanent magnet motor. The stator element and part of the rotor of the first prototype machine exist, and the HTSC magnet replica segments are being fabricated. GRA

N91-13282# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
MICROSTRUCTURAL EVOLUTION IN RAPIDLY SOLIDIFIED Cu-Nb POWDERS
K. L. Zeik, I. E. Anderson, P. R. Howell, and D. A. Koss 22 Aug. 1990 30 p
(Contract N00014-86-K-0381)
(AD-A225860; TR-17) Avail: NTIS HC/MF A03 CSCL 20/2

High pressure inert gas atomization has been used to produce rapid solidification Cu-21.2wt percent Nb powders with a range of particle sizes and microstructures. The associated microstructures depend on particle size. Specifically, fine-scale particles are characterized by a predominance of Nb-rich, multiphase spheroids and a small population of nearly pure Nb dendrites in an almost pure matrix of Cu. In contrast, large particles contain only Nb dendrites in a Cu matrix. The volume fraction of second phase is much lower in the latter instance than in the former. The change in microstructure with particle size is believed to be a result of both the amount of undercooling and cooling rate of the liquid droplets prior to and during solidification. In particular, the large undercoolings in the fine particles are believed to induce a non-equilibrium liquid phase separation which results in a high volume fraction of spheroidal, multiphase Nb-Cu particles within a Cu-rich matrix containing Nb dendrites. GRA

N91-13283# State Univ. of New York, Buffalo. Dept. of Chemistry.
CHANGE IN DENSITY OF STATES IN A RESONANT TUNNELING STRUCTURE DUE TO A SCATTERING CENTER IN THE WELL
L. N. Pandey, Thomas F. George, M. L. Rustgi, and D. Sahu (Computer Sciences Corp., Lanham, MD.) Aug. 1990 27 p Submitted for publication
(Contract N00014-90-J-1193)
(AD-A225861; UBUFFALO/DC/90/TR-21) Avail: NTIS HC/MF A03 CSCL 20/12

The change in density of states and transmission resonance energy shifts were calculated for a double-barrier single quantum well heterostructure by placing a scattering center in the middle of the well and representing it by a thin barrier of variable height and fixed width or a delta-function potential of variable strength. It is found that the energies of the even resonance states shift towards the higher energies, and states get broader as the height of the thin barrier increases. Similar behavior is observed for the delta function potential as the strength of the delta function potential increases. The peak value of the density of states versus energy plot are reduced for even resonance states due to the broadening of these states. The physical processes related with these behavior are discussed. Moreover, there are no changes in the odd resonance states because of the nature of their wave functions in the well region of the resonant tunneling structure. GRA

N91-13284# North Carolina Univ., Raleigh. Dept. of Materials Science and Engineering.
PSEUDOMORPHIC SEMICONDUCTING HETEROSTRUCTURES FROM COMBINATIONS OF AlN, GaN AND SELECTED SiC POLYTYPES: THEORETICAL ADVANCEMENT AND ITS COORDINATION WITH EXPERIMENTAL STUDIES OF NUCLEATION, GROWTH, CHARACTERIZATION AND DEVICE DEVELOPMENT Annual Report, 1 Jan. - 30 Jun. 1990
Robert F. Davis, Max W. H. Braun, Larry Rowland, and Zlatko Sitar Jul. 1990 51 p
(Contract N00014-90-J-1427)
(AD-A225893) Avail: NTIS HC/MF A04 CSCL 20/12

In this reporting period, studies have been conducted in three primary areas: (1) development and application of computer codes concerned with pseudomorphic structures (specifically the cBN-diamond system), the growth of GaN/AlN pseudomorphic heterostructures and the design and fabrication of a growth system for the deposition of SiC/AlN/GaN pseudomorphic structures. Low index planes ((111), (110), (100) and (221)) have been shown to be geometrically favorable for the growth of cBN on diamond. For the first time, pseudomorphic heterostructures between GaN and AlN have been achieved and characterized. A molecular beam epitaxy/atomic layer epitaxy (MBE/ALE) system has been designed and is under construction for the deposition of AlN/GaN/SiC pseudomorphic heterostructures. GRA

N91-13285# North Carolina Univ., Raleigh. Dept. of Materials Science and Engineering.
GROWTH, NITROGEN VACANCY REDUCTION AND SOLID SOLUTION FORMATION IN CUBIC GaN THIN FILMS AND THE SUBSEQUENT FABRICATION OF SUPERLATTICE STRUCTURES USING AlN AND InN Semiannual Report, 1 Jan. - 30 Jun. 1990
Robert F. Davis, Michael J. Paisley, and Zlatko Sitar Jul. 1990 69 p
(Contract N00014-86-K-0686)
(AD-A225894) Avail: NTIS HC/MF A04 CSCL 20/5

In the research of this reporting period, AlN films and AlN/GaN layered structures have been grown and structurally, chemically and optically characterized. In addition, BN has been similarly deposited on cubic Beta-SiC and diamond substrates. Strained layer superlattices have been fabricated for the first time between GaN and AlN. The energy offset was up to 260 meV for the superlattices with the thinnest barriers. Cubic BN was deposited on the aforementioned substrates; however, significant carbon was also present. The latter problem has now been resolved. GRA

N91-13286# Missouri Univ., Columbia. Dept. of Physics.
SPECTROSCOPIC STUDIES OF GaAs/AlGaAs SUPERLATTICES UNDER HYDROSTATIC AND UNIAXIAL PRESSURES AT 8 TO 300 K Final Report, 15 May 1986 - 31 May 1990
Meera Chandrasekhar 25 Jul. 1990 66 p
(Contract DAAL03-86-K-0083)
(AD-A225925; ARO-23332.18-PH) Avail: NTIS HC/MF A04 CSCL 09/1

We report on our spectroscopy investigations of bulk semiconductors and quantum well heterostructures under

hydrostatic pressures at low temperatures (5 to 300 K). We have studied several semiconducting materials: bulk AlGaAs, GaAs/AlGaAs quantum well heterostructures (QWH), GaSb/AlSb QWH, and the II-VI alloys, CdMnTe. The motivating factor in all the studies was to use pressure as a tool to uncover fundamental properties of the materials that were directly of value in the design of devices. In order to conduct these studies we have become, to our knowledge, the only group in the world that conducts photoreflectance measurements under pressure in a diamond anvil cell. We are also known for our photoluminescence study at low temperatures and high pressures. In the GaAs/AlGaAs QWH we made a direct measurement of the valence band offset via an elegant pressure measurement, settling a controversy that was ten years old when we reported it in 1986. The VB offset is the single most important quantity that determines the design of GaAs/AlGaAs devices. GRA

N91-13287# David Sarnoff Research Center, Princeton, NJ.
MOCVD SYNTHESIS OF THALLIUM SUPERCONDUCTOR MATERIALS Final Report, 25 Jul. 1989 - 28 Feb. 1990
31 Jul. 1990 37 p
(Contract N00014-89-C-0111)
(AD-A225932) Avail: NTIS HC/MF A03 CSCL 09/1

Superconducting films of Tl2Ba2Ca1Cu2Ox were produced on Al2O3 and LaAlO3 substrates via a two step process. Initially, an oxide precursor containing barium, calcium, and copper was deposited by either MOCVD or a chemical deposition process. Subsequently, thallium was added to the precursor by vapor transport from a solid source in order to form the superconducting phase. The chemical, physical, and superconducting properties of the resultant films were characterized. The quality of the films obtained from the two types of precursors appears to be equivalent. Highly c-axis oriented films of the 2212 phase were prepared on both substrate types. GRA

N91-13288# Oklahoma Univ., Norman.
RAPID ISOTHERMAL PROCESSING OF THE THIN EPITAXIAL CaF2 DIELECTRIC FILMS FOR ADVANCED Si RADIATION TOLERANT INTEGRATED CIRCUITS Final Report, 1 Jul. 1987 - 31 May 1990
Rajendra Singh 1990 15 p
(Contract DAAL03-87-K-0081)
(AD-A225995; ARO-25046.17-EL-SDI) Avail: NTIS HC/MF A03 CSCL 20/13

This report contains research results in the areas of in-situ rapid isothermal processing, in-situ cleaning of semiconductor surfaces, solid phase epitaxial growth of II-A fluorides, in-situ metallization, the role of thermal stress, use of II-A fluorides as buffer layers for the decomposition of high temperature superconducting thin films and the set up of rapid isothermal processing (RIP) assisted metal oxide chemical vapor deposition (MOCVD). GRA

N91-13289# Aerodyne Research, Inc., Billerica, MA.
DEVELOPMENT OF LASER SPECTROSCOPIC DIAGNOSTICS TO SUPPORT ADVANCED COMPOUND SEMICONDUCTOR DEPOSITION TECHNIQUES Final Technical Report, 1 Jun. 1987 - 1 Jun. 1990
Joda C. Wormhoudt 30 Jul. 1990 110 p
(Contract F49620-87-C-0052)
(AD-A226057; AFOSR-90-0865TR) Avail: NTIS HC/MF A06 CSCL 20/12

This program constructed and demonstrated an apparatus for the development of laser diagnostics for the gas phase molecules involved in semiconductor fabrication techniques, particularly the organometallic chemical vapor deposition of compound semiconductors like gallium arsenide. Work on this apparatus, a flow tube with mirrors for long path tunable infrared diode laser absorption and electrodes for a radio frequency glow discharge, culminated in observations designed to assess the importance of arsenic hydride radicals in the decomposition of organoarsenic compounds. Preliminary observations of fluorocarbon and methane plasmas produced observations of several species which could be compared with models and other observations and which added to knowledge of these systems with their important applications in silicon etching an diamond deposition. The program also resulted in band strength measurements for the methyl and difluorocarbene radicals, using tunable diode laser, dye laser, and fast flow reactor techniques. GRA

N91-13290# Arizona State Univ., Tempe. Dept. of Electrical and Computer Engineering.
IN SITU GSMBE GROWTH MONITORING FOR OPTOELECTRONIC DEVICES Final Report, 1 Dec. 1988 - 31 May 1990
George N. Maracas 9 Jul. 1990 8 p
(Grant AF-AFOSR-0180-89; AF Proj. 3842)
(AD-A226143; AFOSR-90-0870TR) Avail: NTIS HC/MF A02 CSCL 20/12

Presented is the establishment of a semiconductor optical properties characterization facility constructed at Arizona State University under the sponsorship of an AFOSR-URIP. The fully computerized system is connected to our MBE and electrical properties characterization laboratory network and will be used for two purposes: (1) to study the properties of photonic materials and devices, and (2) to study the growth kinetics in solid source and Gas Source Molecular Beam Epitaxy (GSMBE). As a result of these efforts, a coherent research program has been established that stresses the following points: (1) collaborative research among engineering, physical science and materials science faculty specifically in the field of compound semiconductor (GaAs, AlGaAs, InGaAs and InP based) materials with emphasis on heterojunction and quantum well structures; (2) diagnostics of novel optoelectronic devices and materials; (3) interaction with our strong theoretical efforts to identify new directions MBE growth and optoelectronic and nanostructure device physics. Several productive DoD programs have been obtained which utilize the equipment for student training and technical publications. The instrumentation has provided a capability for scientific research that is unique in any U.S. university. Thus the training of students of modern instrumentation to effectively pursue present and future DoD research directions is progressing successfully. GRA

N91-13291# Varian Associates, Palo Alto, CA.
HIGH TEMPERATURE SUPERCONDUCTIVITY Quarterly Report, period ending 30 Jun. 1990
James N. Eckstein 27 Aug. 1990 8 p
(Contract N00014-88-C-0760)
(AD-A226297) Avail: NTIS HC/MF A02 CSCL 20/12

The overall goals are to develop the technology of Molecular Beam Epitaxy (MBE) growth of HTSC material, to optimize the performance of High Temperature SuperConducting (HTSC) films with high transition temperatures and critical current densities, and to explore the development of electronic devices based on such material. The recently developed MBE system is functioning well, and superconducting films with T sub c's above 77 K are now routinely being grown, in-situ, by atomic layer epitaxy on both MgO and SrTiO3. Work is continuing on understanding such issues as required stoichiometric control and methods of improving kinetic control precision, oxidation capacities of reactive oxygen sources, and the effect of crystallographic quality on superconducting properties. GRA

N91-13292# Varian Associates, Palo Alto, CA.
HIGH TEMPERATURE SUPERCONDUCTIVITY Quarterly Report, period ending 31 Mar. 1990
James N. Eckstein 1 Aug. 1990 8 p
(Contract N00014-88-C-0760)
(AD-A226298) Avail: NTIS HC/MF A02 CSCL 20/12

The overall goals of this program are to develop the technology of MBE growth of HTSC material, to optimize the performance of HTSC films with high transition temperatures and critical current densities, and to explore the development of electronic devices based on such material. The recently developed MBE system is functioning well and superconducting films with TcS' above 77 K are now routinely being grown, in-situ, by atomic layer epitaxy on

both MgO and SrTiO3. Work is continuing on understanding such issues as required stoichiometric control and methods of improving kinetic control precision, oxidation capacities of reactive oxygen sources, and the effect of crystallographic quality on superconducting properties. Work has continued on studying the growth of layered superconductors using atomically layered epitaxy. An incremental improvement in the measured transition temperature was obtained, from 84 to 86 K. This was from a nominal 2223-phase film. GRA

N91-13293# Lowell Univ., MA. Dept. of Chemistry.
DYNAMICS SIMULATION OF LANGMUIR-BLODGETT FILMS
S. B. Clough, X. F. Sun, Jayant Kumar, and Sukant Tripathy Apr. 1990 4 p
(Contract N00014-90-J-1148)
(AD-A226327; TR-13) Avail: NTIS HC/MF A01 CSCL 20/2

Langmuir-Blodgett film monolayers are formed when amphiphilic molecules in solution are deposited on water surface followed by compression. During the compression, the randomly oriented molecules reorient themselves with the hydrophilic head groups on the water surface and the hydrophobic tail standing away from the water surface. The organic ultra-thin films with highly ordered layer structure, have shown a wide range of potential applications in biochemistry, microelectronics, integrated optics, micro-lithography, and many other fields. It is very important to get a better understanding of the relationship between the properties of the films and the micro-structure, for example, the molecular conformation, packing, orientation and motion in the films. For this purpose, within the past few years, different computer simulation methods were applied on LB film monolayers, including Monte Carlo methods and molecular dynamics simulations. GRA

N91-13294# Astropower, Inc., Newark, DE.
THIN CRYSTALLINE InP ON INSULATING SUBSTRATES Final Technical Report, 15 Aug. 1989 - 15 Feb. 1990
Sandra R. Collins, James B. McNeely, and Allen M. Barnett 14 May 1990 18 p
(Contract DAAL03-89-C-0025)
(AD-A226386; ARO-27321.1-EL-SBI) Avail: NTIS HC/MF A03 CSCL 20/3

This program has successfully developed device quality InP films on insulating substrates. A low cost deposition technique was established which produced mechanically stable, stoichiometric InP films on insulating substrates. The substrate has a thermal expansion coefficient matched to InP for temperatures up to 600 C. Device quality was established by the fabrication and successful operation of Schottky barrier diodes. Device performance comparisons of these devices with identical structures on large grain commercial polycrystalline InP material and LEC single crystal InP material provided a relative basis for analysis of material quality. Device performance was found to be dependent on the grain size of the InP films. The quality of the InP/Glass photodiodes fabricated and tested during this program indicate the high device potential of these films for grain sizes exceeding 10 microns. Larger grain InP films are needed to provide more conclusive findings on the optimum grain size for device applications. GRA

N91-13295# Sandia National Labs., Albuquerque, NM.
A JOSEPHSON JUNCTION TO FET HIGH SPEED LINE DRIVER MADE OF TlCaBaCuO
J. S. Martens, D. S. Ginley, J. B. Beyer, J. E. Nordman, and G. K. G. Hohenwarter (Hypress, Inc., Elmsford, NY.) 1990 20 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990
(Contract DE-AC04-76DP-00789)
(DE90-017542; SAND-90-2244C; CONF-900944-1) Avail: NTIS HC/MF A03

We have used a Tl-Ca-Ba-Cu-O superconducting flux flow transistor (SFFT) as an active impedance converter between Josephson and FET circuitry. The input of the flux flow device is a control line of low impedance that can be driven by a tunnel junction. The output is the signal across the SFFT which is made of a parallel array of weak links. The output impedance is typically greater than 5 Ohm with a maximum voltage swing of over 100 mV into a 50 Ohm system. The switching of an all-Nb junction induced a 90 mV voltage swing at the FET input and over 200 mV at the FET output. The line driver can operate anywhere between 4.2 and 85 K with minor changes in speed (plus or minus 5 ps) and output level (plus or minus 10 mV). The switching time measured was about 100 ps and was fixture limited. DOE

N91-13296# Sandia National Labs., Albuquerque, NM.
SOLID STATE RADIOLUMINESCENT SOURCES USING ZEOLITES
John T. Gill, Daniel B. Hawkins (Alaska Univ., Fairbanks.), and Clifford L. Renschler 1990 6 p Presented at the Radioluminescent Technology Conference, Annapolis, MD, 25-26 Sep. 1990
(Contracts DE-AC04-76DP-00789; DE-AC04-88DP-43495)
(DE90-017594; SAND-90-2217C; CONF-9009201-5) Avail: NTIS HC A02

Inorganic zeolites show promise as an alternative to traditional tritium gas tube light sources. Greater proximity of tritium atoms and luminescing centers, as well as greater tritium loading density, have been obtained within the zeolite aluminosilicate matrix. Zeolites are in addition optically clear and radiation stable. The zeolite radioluminescence program is described. Procedures for obtaining light sources are presented and results are discussed. DOE

N91-13297# Los Alamos National Lab., NM.
MICROWAVE PROPERTIES OF HTS FILMS
D. W. Cooke, P. N. Arendt, E. R. Gray, R. E. Muenchausen, B. L. Bennett, S. R. Foltyn, R. C. Estler, X. D. Wu, G. A. Reeves, and N. E. Elliott et al 1990 11 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990
(Contracts W-7405-eng-36; DE-AC03-76SF-00098)
(DE91-000211; LA-UR-90-3268; CONF-901105-12) Avail: NTIS HC/MF A03

High-frequency applications of High-Temperature Superconductors (HTS) generally fall into two categories: devices that require low values of surface resistance R(sub s) in ambient surface magnetic fields H(sub RF), and devices that require low R(sub s) in modest fields. Moreover, many applications can be realized with small-surface-area films whereas others require larger areas-radiofrequency (RF) cavities, for example. Regardless of the application, the potential of HTS films is predicated on satisfying one or both of the above-stated requirements. We have measured the surface resistance of small-area (1 sq cm) and large-area (6.5 sq) YBa2Cu3O7 (YBCO) films that have been laser ablated onto LaAlO3 substrates, large-area (5.1 sq cm) YBCO films that have been e-beam deposited onto LaAlO3, and large-area (11.4 sq cm) Tl-based films that have been magnetron sputtered onto metallic substrates. The best R(sub s) values are obtained from the 1 sq cm laser-ablated films; they are 40 and 340 micro-ohm at 4 and 77 K, respectively (omega/2pi = 10 GHz). Comparable values for Cu are 6 and 13 milli-ohm, respectively. Large-area Tl-based films yield typical R(sub s) values of 4 and 14 milli0ohm at 4 and 77 K, respectively (omega/2pi = 18 GHz). The dependence of R(sub s) on H(sub RF) for these films indicates that surface fields as large as 55 Oe can be achieved with R(sub s) increasing only by a factor of 10. This field dependence is associated with c-axis texturing. DOE

N91-13298# Los Alamos National Lab., NM.
MODELLING OF DUAL STABILITY IN A CABLE-IN-CONDUIT CONDUCTOR
L. Bottura (Max-Planck-Inst. fuer Plasmaphysik, Garching, Germany, F.R.) and J. V. Minervini 1990 12 p Presented at the Applied Superconductivity Conference, Aspen, CO, 24-28 Sep. 1990
(Contract W-7405-eng-36)
(DE91-000220; LA-UR-90-3233; CONF-900944-4) Avail: NTIS HC/MF A03

A zero-dimensional stability model has been developed for

cable-in-conduit superconductors. The model is effective in simulating the multi-valued stability behavior in the vicinity of the limiting current. This has been by modifying the helium heat transfer coefficient to account for inertial and fractional terms which affect the induced helium flow. Although this effect is treated qualitatively on a pseudo-one-dimensional basis, the model can reproduce with remarkable accuracy the multi-valued stability behavior shown in earlier measurements performed by Lue, et al. The influence of the steady state mass flow is discussed, and a first order approximation of its effect is introduced in the model showing how an increase of the steady flow tends to 'wash-away' the multiple stability region as observed in the experiment. DOE

N91-13299# Lawrence Livermore National Lab., CA.
STRATEGY AND TACTICS IN THE SEARCH FOR NEW HARMONIC GENERATING CRYSTALS
Stephan P. Velsko Sep. 1990 24 p Presented at the American Chemical Society (ACS) Symposium on Non-Linear Materials (NLO) Conference, Boston, MA, 23 Apr. 1990
(Contract W-7405-eng-48)
(DE91-000281; UCRL-JC-105000; CONF-9004244-1) Avail: NTIS HC/MF A03

Three basic questions must be answered to ensure success in the search for an optimized nonlinear crystal for a particular application: What are the most important optical properties which determine the crystal's figure of merit for the intended application. What is the best methodology for characterizing those optical properties so that materials of interest can be identified efficiently. Where in materials space can crystals with such properties be found with the highest probability. Answers to these questions will be discussed in the context of a program to find improved frequency conversion crystals for high power lasers. DOE

N91-13300# Los Alamos National Lab., NM.
THERMODYNAMICS AND MAGNETISM IN Th(x)U(1-x)Be(13-y)B(y)
R. H. Heffner, W. P. Beyermann, M. F. Hundley, J. D. Thompson, J. L. Smith, Z. Fisk, K. Bedell, P. Birrer, C. Baines, and F. N. Gygax (Eidgenoessische Technische Hochschule, Zurich, Switzerland) et al 1990 14 p Presented at the Conference on Magnetism and Magnetic Materials, San Diego, CA, 30 Oct. - 2 Nov. 1990
(Contract W-7405-eng-36)
(DE91-000372; LA-UR-90-3170; CONF-901004-6) Avail: NTIS HC/MF A03

We report specific heat and muon Spin Rotation (mu-SR) measurements on Th (x = 0.019) and/or B (y = 0.03) substituted UBe(13). The specific heat data show that either Th or B substitution reduces the Kondo temperature T(sub K) and increases the entropy at the superconducting transition by almost 20 percent, indicating an enhanced density of states. However, whereas mu-SR shows clear evidence for magnetic correlations for Th substitutions (x is between 0.019 and 0.043), no magnetism is observed for B substitutions. The enhanced specific heat jump in the B-substituted material is associated with a change in the superconducting properties as T(sub K) is reduced. DOE

N91-13301# Los Alamos National Lab., NM.
PHOTOABSORPTION MODULATION IN GaAs: Ga(1-x)In(x) AS STRAINED-LAYER SUPERLATTICES
I. Sella, D. E. Watkins, B. K. Laurich, D. L. Smith, S. Subbanna, and H. Kroemer (California Univ., Santa Barbara.) 1990 5 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract W-7405-eng-36)
(DE91-000440; LA-UR-90-2976; CONF-901105-14) Avail: NTIS HC/MF A01

Photoabsorption modulation measurements have been made on Ga(1-x)In(x)As - GaAs strained-layer superlattices using two approaches: In the first the modulating beam and the test beam have the same wavelength (near the exciton resonance). In the second, the modulation wavelength is much shorter than the test beam wavelength. A dramatic difference is observed in the modulated transmission spectra near the excitonic level for the two modulating wavelengths. The difference in behavior can be explained by screening of the residual surface electric field, which only occurs for the high photon energy modulating beam. This beam excites carriers that are free to drift in the surface field before they are captured in the quantum wells. Carriers excited by the low photon energy modulation beam are created in the wells and can not effectively screen the surface field. We describe a model which explains the nonlinear intensity saturation profile and qualitatively describes the spectral line shape. DOE

N91-13302# Oak Ridge National Lab., TN. Solid State Div.
PATTERNING AND OVERGROWTH OF NANOSTRUCTURE QUANTUM WELL WIRE ARRAYS BY LP-MOVPE (LOW PRESSURE-METALORGANIC VAPOR PHASE EPITAXY)
N. H. Karam, A. Mastrovito, V. Haven, K. Ismail, S. Pennycook, and H. I. Smith (Massachusetts Inst. of Tech., Cambridge.) Jun. 1990 15 p Presented at the 5th International Conference on Metalorganic Vapor Phase Epitaxy, Aachen, Fed. Republic of Germany, 18-20 Jun. 1990 Submitted for publication Sponsored in part by ARO
(Contract DE-AC05-84OR-21400)
(DE91-000717; CONF-9006174-2; TR-90-09) Avail: NTIS HC/MF A03

Nanometer scale GaAs Quantum Well Wire (QWW) arrays with lateral dimensions in the range of 10 to 70 nm and a period of 200 nm have been fabricated in the GaAs/AlGaAs system using x-ray nanolithography patterning and overgrowth by a low pressure Metalorganic Vapor Phase Epitaxy (LP-MOVPE) technique. The QWW structures were either fabricated by post-growth patterning of a thin GaAs film on a AlGaAs-coated substrate followed by AlGaAs deposition, or by continuous in situ deposition of a GaAs/AlGaAs QWW structure on a prepatterned GaAs substrate. Although cross-sectional transmission electron microscopy showed no structural defects in either QWW fabrication process, photoluminescence (PL) was only observed in the in situ-deposited structures. Strong polarization dependence of the PL peak with respect to wire orientation has been confirmed and evidence of lateral confinement was observed. DOE

N91-13303# Florida Univ., Gainesville. Dept. of Chemical Engineering.
THE COUPLING OF THERMOCHEMISTRY AND PHASE DIAGRAMS FOR GROUP III-V SEMICONDUCTOR SYSTEMS Progress Report, 1 Sep. 1989 - 30 Apr. 1990
T. J. Anderson 1990 17 p
(Contract DE-FG05-86ER-45276)
(DE91-000934; DOE/ER-45276/4) Avail: NTIS HC/MF A03

Progress in the first year of the renewal and fourth year of the program has primarily occurred in the experimental area and subsequent assessment of binary and ternary systems. Thermodynamic studies of the Al-In and Al-Sb systems have been carried out using solid electrolyte galvanic cells. Using the sensitive coulometric titration technique, aluminum activities were obtained for both systems. In addition, liquidus data were obtained for the Al-Sb system, and the Gibbs energy of formation of AlSb was determined. A detailed description of the work for the Al-In system is given in Appendix 1 while that for the Al-Sb system in Appendix 2. For the Al-Sb system, the coulometric titration technique was also used to investigate, for the first time, the very narrow region of homogeneity in the Al-Sb compound. The experimental data obtained in this study were used along with the available literature data in the critical assessment and calculation of the Al-In and Al-Sb systems. DOE

N91-13304# Brookhaven National Lab., Upton, NY. Dept. of Physics.
SOME ASPECTS OF THE THEORY OF HIGH TEMPERATURE SUPERCONDUCTORS
V. J. Emery 1990 19 p Presented at the 19th International Conference on Low Temperature Physics, Brighton, England, 16-22 Aug. 1990

(Contract DE-AC02-76CH-00016)
(DE91-000903; BNL-45146; CONF-900806-10) Avail: NTIS HC/MF A03

A qualitative survey of the theory of high temperature superconductors as strongly correlated electron systems is presented. Various microscopic models and their implications for the theory of the normal state are described. Constraints on the mechanism and many body theory of the superconducting state are discussed. DOE

N91-13315*# Clemson Univ., SC. Dept. of Ceramic Engineering.
HIGH Tc SUPERCONDUCTING MATERIALS AND DEVICES
Gene H. Haertling *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 52-53 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20L

N91-13320*# Hampton Univ., VA. Dept. of Mathematics.
A STUDY OF THE APPLICABILITY OF GALLIUM ARSENIDE AND SILICON CARBIDE AS AEROSPACE SENSOR MATERIALS
John S. Hurley *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 62-63 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20L

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N91-13305 Johns Hopkins Univ., Baltimore, MD.
FIELD THEORETIC APPROACH TO STATISTICAL DYNAMICS AND CHAOS Ph.D. Thesis
Gerardo Andres Munoz 1990 87 p
Avail: Univ. Microfilms Order No. DA9018613

Classical statistical dynamics, the theory of classical (usually nonlinear) systems, in which randomness is introduced by means of stochastic external driving terms and/or random initial conditions, is studied from a field theoretic point of view. The physically relevant quantities are averages over these random variables, and can be calculated from a path integral representation of a generating functional, in close analogy with quantum field theory. After reviewing the functional approach an unsatisfactory feature of the traditional formulation is discussed, namely the ill-defined manipulations performed on a determinant that arises due to the constrained nature of the theory. Exponentiation of this determinant is shown using anticommuting variables. This leads to an extended action possessing a Becchi-Rouet-Stora (BRS) symmetry, and the induced Ward identities permit a clean resolution of the problem mentioned above. The potential applications of the formalism are certainly many, but few are as challenging as systems exhibiting chaotic behavior. A very concise introduction to the necessary concepts in chaos is presented. A perturbative investigation of the effects of stochasticity on such systems in general, and on their Lyapunov exponents in particular is also presented. Finally, the transition from regular to chaotic behavior is analyzed using renormalization group (RG) equations. The presence of initial conditions and nonvanishing average fields requires a revision of the translation invariant approach followed in quantum field theory. The RG equations that emerge after taking into account the necessary modifications lead to a relation for Lyapunov exponents that can be used to compute them in specific cases. They also imply a result describing how the critical stress scales with the amplitude of the external noise. Dissert. Abstr.

N91-13306# Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics.
TOPOLOGICAL ASPECTS OF CLASSICAL AND QUANTUM (2+1)-DIMENSIONAL GRAVITY Thesis
Jiro Soda Mar. 1990 58 p
(DE90-513792; RRK-90-4) Avail: NTIS (US Sales Only) HC A04

To understand (3+1)-dimensional gravity, (2+1)-dimensional gravity is studied as a toy model. Our emphasis is on its topological aspects, because (2+1)-dimensional gravity without matter fields has no local dynamical degrees of freedom. Starting from a review of the canonical ADM formalism and York's formalism for the initial value problem, we will solve the evolution equations of (2+1)-dimensional gravity with a cosmological constant in the case of g=0 and g=1, where g is the genus of Riemann surface. The dynamics of it is understood as the geodesic motion in the moduli space. This remarkable fact is the same with the case of (2+1)-dimensional pure gravity and seen more apparently from the action level. Indeed we will show the phase space reduction of (2+1)-dimensional gravity in the case of g=1. For g (ge) 2, unfortunately we are not able to explicitly perform the phase space reduction of (2+1)-dimensional gravity due to the complexity of the Hamiltonian constraint equation. Based on this result, we will try to incorporate matter fields into (2+1)-dimensional pure gravity. The linearization and mini-superspace methods are used for this purpose. By using the linearization method, we conclude that the transverse-traceless part of the energy-momentum tensor affects the geodesic motion. In the case of the Einstein-Maxwell theory, we observe that the Wilson lines interact with the geometry to bend the geodesic motion. We analyze the mini-superspace model of (2+1)-dimensional gravity with matter fields in the case of g=0 and g=1. For g=0, a wormhole solution is found but for g=1 we can not find an analogous solution. Quantum gravity is also considered, and we perform the phase space reduction of (2+1)-dimensional gravity in the case of g=1 at the quantum level. From this analysis we argue that the conformal rotation is not necessary in the sense that the Euclidean quantum gravity is inappropriate for the full gravity. DOE

N91-13307# Martin Marietta Labs., Baltimore, MD.
ELECTROOPTICAL QUANTUM WELLS Final Technical Report, Mar. 1987 - Oct. 1988
Richard P. Leavitt, John W. Little, and K. J. Ritter Oct. 1989 90 p
(Contract F19628-86-C-0059; AF Proj. 4600)
(AD-A226102; RADC-TR-89-213) Avail: NTIS HC/MF A05 CSCL 20/6

A detailed study of electro refraction and electro absorption in a new semiconductor quantum well system known as an asymmetric coupled quantum well is presented. Resonant coupling of electron levels in a closely-spaced pair of quantum well is shown to modify the exciton absorption spectrum and, through the Kramers-Kronig relation, lead to substantial changes in the index of refraction of single mode waveguides at wavelengths much longer than the absorption edge of the guide. Intensity and phase modulators were fabricated and tested using GaAs/AlGaAs quantum wells (for operation at 0.86 to 0.95 micron) and InGaAs/InAlAs wells lattice matched to InP substrates for use at 1.55 micron. GRA

N91-13308# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physikalische Ingenieurwissenschaft.
FOR THE HIERARCHY OF THE EXTENDED THERMODYNAMICS Ph.D. Thesis [ZUR HIERARCHIE DER ERWEITERTEN THERMODYNAMIK]
Wolf Weiss 1990 200 p In GERMAN
(ETN-90-98182) Avail: NTIS HC/MF A09

The parabolic usual field equations are replaced by symmetrical hyperbolic field equations. Explicit field equations for ideal gases were differentiated on the basis of the Boltzmann equation. The relation between the dynamic structure factor and the spectrum of a laser ray irradiating a gas was observed and the structure factor was calculated as well as the dispersion relation between

the phase velocity, the damping and the frequency. A criterium for the number of necessary variables for a given process was studied. It seems that this number increases with the frequency in order to obtain converging results. ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N91-13309*# Hampton Univ., VA.
NASA/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM, 1990
John H. Spencer, comp. Sep. 1990 146 p Fellowship program held in Hampton, VA, 4 Jun. - 10 Aug. 1990
(Grant NGT-47-020-800)
(NASA-CR-182092; NAS 1.26:182092) Avail: NTIS HC/MF A07 CSCL 05I

Since 1964, NASA has supported a program of summer faculty fellowships for engineering and science educators. The objectives are to further the professional knowledge of qualified engineering and science members; to stimulate and exchange ideas between participants and NASA; to enrich and refresh the research and teaching activities of participants' institutions; and to contribute to the research objectives of the NASA center. The study program consists of lectures and seminars on topics of interest or that are directly relevant to the research topics. For individual titles, see N91-13310 through N91-13346.

N91-13310*# North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Mechanical Engineering.
TURBULENCE MODELING FOR HIGH SPEED COMPRESSIBLE FLOWS **c34**
Suresh Chandra *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 39-42 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

Turbulence models are necessary in numerical simulations because of the impracticality of computing all scales of turbulent motion. Approximate methods, or turbulence models, are introduced to simplify and make the computations practical. There are several approaches to turbulence modeling: subgrid scale modeling; modeling of all the scales of turbulent motion; eddy viscosity; and Reynolds stress turbulence closure models. In many instances, computations based on turbulence models are compared with available experimental data. The effort is directed at seeking models which have reasonable accuracy over a limited range of flow conditions. Future needs are briefly discussed. Work to date is outlined. Author

N91-13311*# University of Central Florida, Orlando. Dept. of Electrical Engineering.
MUTUAL COUPLING BETWEEN CIRCULAR APERTURES ON AN INFINITE CONDUCTING GROUND PLANE AND RADIATING INTO A FINITE WIDTH SLAB **c32**
Christos Christodoulou *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 43-45 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20N

The problem of electromagnetic coupling between two horns is of interest for the Microwave Reflectometer Ionization Sensor (MRIS) that will be used in the Aeroassist Flight Experiment (AFE). Laboratory measurements of mutual coupling between conical horns (using a flat metallic reflector to simulate a critically dense plasma outside) have shown a strong dependence on the finite dimensions of the shuttle tile over the apertures. Since both, the dielectric tile and the plasma outside the tile reflect microwaves, a study should be done to isolate the two mechanisms so that the MRIS reentry flight data can be interpreted correctly. Once the coupling due to the tile itself is determined then the location of the critial electron number density layers can be determined. As a first attempt to tackle this problem the Geometrical Theory of Diffraction was used to modify the existing solution to mutual coupling between apertures with infinite dielectric sheets. By using the equivalent current method, aperture theory to determine the radiated fields inside the dielectric tiles, and ray tracing the contributions to mutual coupling were determined. Results from two cases with different tile thicknesses have indicated that the main contribution to mutual coupling is due to diffraction from the bottom and top (back and front) wedges. Author

N91-13312*# Valparaiso Univ., IN. Dept. of Mechanical Engineering.
AN INVESTIGATION OF DESIGN OPTIMIZATION USING A 2-D VISCOUS FLOW CODE WITH MULTIGRID **c34**
Michael L. Doria *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 46-47 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

Computational fluid dynamics (CFD) codes have advanced to the point where they are effective analytical tools for solving flow fields around complex geometries. There is also a need for their use as a design tool to find optimum aerodynamic shapes. In the area of design, however, a difficulty arises due to the large amount of computer resources required by these codes. It is desired to streamline the design process so that a large number of design options and constraints can be investigated without overloading the system. There are several techniques which have been proposed to help streamline the design process. The feasibility of one of these techniques is investigated. The technique under consideration is the interaction of the geometry change with the flow calculation. The problem of finding the value of camber which maximizes the ratio of lift over drag for a particular airfoil is considered. In order to test out this technique, a particular optimization problem was tried. A NACA 0012 airfoil was considered at free stream Mach number of 0.5 with a zero angle of attack. Camber was added to the mean line of the airfoil. The goal was to find the value of camber for which the ratio of lift over drag is a maximum. The flow code used was FLOMGE which is a two dimensional viscous flow solver which uses multigrid to speed up convergence. A hyperbolic grid generation program was used to construct the grid for each value of camber. Author

N91-13313*# State Univ. of New York, Buffalo. Dept. of Mechanical and Aerospace Engineering.
HIGH SPEED TURBULENT REACTING FLOWS: DNS AND LES **c34**
Peyman Givi *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 48-49 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

Work on understanding the mechanisms of mixing and reaction in high speed turbulent reacting flows was continued. Efforts, in particular, were concentrated on taking advantage of modern computational methods to simulate high speed turbulent flows. In doing so, two methodologies were used: large eddy simulations (LES) and direct numerical simulations (DNS). In the work related with LES the objective is to study the behavior of the probability density functions (pdfs) of scalar properties within the subgrid in reacting turbulent flows. The data base obtained by DNS for a detailed study of the pdf characteristics within the subgrid was used. Simulations are performed for flows under various initializations to include the effects of compressibility on mixing and chemical reactions. In the work related with DNS, a two-dimensional temporally developing high speed mixing layer under the influence of a second-order non-equilibrium chemical reaction of the type A + B yields products + heat was considered. Simulations were performed with different magnitudes of the convective Mach numbers and with different chemical kinetic parameters for the purpose of examining the isolated effects of the compressibility and the heat released by the chemical reactions

on the structure of the layer. A full compressible code was developed and utilized, so that the coupling between mixing and chemical reactions is captured in a realistic manner. Author

N91-13314*# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
NATURAL LAMINAR FLOW APPLICATION TO TRANSPORT AIRCRAFT **c05**
Louis B. Gratzer *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 50-51 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 01C

A major goal of NASA during the last 15 years has been the development of laminar flow technology for aircraft drag reduction. Of equal importance is achieving a state of readiness that will allow the successful application of this technology by industry to large, long-range aircraft. Recent progress in achieving extensive laminar flow with limited suction on the Boeing 757 has raised the prospects from practical application of the hybrid laminar flow control (HLFC) concept to subsonic aircraft. Also, better understanding of phenomena affecting laminar flow stability and response to disturbances has encouraged consideration of natural laminar flow (NLF), obtained without suction or active mechanical means, for application to transport aircraft larger than previously thought feasible. These ideas have inspired the current NASA/ASEE project with goals as follows: explore the feasibility of extensive NLF for aircraft at high Reynolds number under realistic flight conditions; determine the potential applications of NLF technology and the conditions under which they may be achieved; and identify existing aircraft that could be adapted to carry out flight experiments to validate NLF technology application. To achieve these objectives, understanding of the physical limits to natural laminar flow and possible ways to extend these limits was sought. The primary factors involved are unit Reynolds number, Mach number, wing sweep, thickness, and lift coefficients as well as surface pressure gradients and curvature. Based on previous and ongoing studies using laminar boundary layer stability theory, the interplay of the above factors and the corresponding transition limits were postulated. Author

N91-13315*# Clemson Univ., SC. Dept. of Ceramic Engineering.
HIGH Tc SUPERCONDUCTING MATERIALS AND DEVICES **c76**
Gene H. Haertling *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 52-53 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20L

The high Tc Y1Ba2Cu3O(7-x) ceramic materials, initially developed in 1987, are now being extensively investigated for a variety of engineering applications. The superconductor applications which are presently identified as of most interest to NASA-LaRC are low-noise, low thermal conductivity grounding links; large-area linear Meissner-effect bearings; and sensitive, low-noise sensors and leads. Devices designed for these applications require the development of a number of processing and fabrication technologies. Included among the technologies most specific to the present needs are tapecasting, melt texturing, magnetic field grain alignment, superconductor/polymer composite fabrication, thin film MOD (metal-organic decomposition) processing, screen printing of thick films, and photolithography of thin films. The overall objective of the program was to establish a high Tc superconductivity laboratory capability at NASA-LaRC and demonstrate this capability by fabricating superconducting 123 material via bulk and thin film processes. Specific objectives include: order equipment and set up laboratory; prepare 1 kg batches of 123 material via oxide raw material; construct tapecaster and tapecaster 123 material; fabricate 123 grounding link; fabricate 123 composite for Meissner linear bearing; develop 123 thin film processes (nitrates, acetates); establish Tc and Jc measurement capability; and set up a commercial use of space program in superconductivity at LaRC. In general, most of the objectives of the program were met. Finally, efforts to implement a commercial use of space program in superconductivity at LaRC were completed and at least two industrial companies have indicated their interest in participating. Author

N91-13316*# Eureka Coll., IL.
NOISE IN LASER OSCILLATOR SYSTEMS **c36**
Joseph C. Hafele *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 54-55 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20E

The aim of the SUNLITE program is to demonstrate the performance of ultra-stable laser systems in the environment of space. The program uses Non-Planar Ring Oscillators (NPRO) which have shown great promise for time and frequency standards with unprecedented resolution and stability. An immediate goal is to test NPRO oscillators in orbital free fall by 1994. During the past year there was remarkable progress in the design and pre-flight testing of the SUNLITE test package. Current theoretical studies are investigating the possible effects of various noise sources on the linewidth and linecenter frequency stability of servocontrolled NPRO lasers. The frequency control system is reviewed and the potential impact on frequency stability of noise sources in the control system and in the environment is considered. Author

N91-13317*# Hampton Univ., VA. Dept. of Mathematics.
ACOUSTIC WAVES SUPERIMPOSED ON INCOMPRESSIBLE FLOWS **c71**
Steve Hodge *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 56-57 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20A

The use of incompressible approximations in deriving solutions to the Lighthill wave equation was investigated for problems where an analytical solution could be found. A particular model problem involves the determination of the sound field of a spherical oscillating bubble in an ideal fluid. It is found that use of incompressible boundary conditions leads to good approximations in the important region of high acoustic wave number. Author

N91-13318*# Wichita State Univ., KS. Dept. of Aerospace Engineering.
EDGE DELAMINATION OF COMPOSITE LAMINATES SUBJECT TO COMBINED TENSION AND TORSIONAL LOADING **c24**
Steven J. Hooper *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 58-59 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 11D

Delamination is a common failure mode of laminated composite materials. Edge delamination is important since it results in reduced stiffness and strength of the laminate. The tension/torsion load condition is of particular significance to the structural integrity of composite helicopter rotor systems. Material coupons can easily be tested under this type of loading in servo-hydraulic tension/torsion test stands using techniques very similar to those used for the Edge Delamination Tensile Test (EDT) delamination specimen. Edge delamination of specimens loaded in tension was successfully analyzed by several investigators using both classical laminate theory and quasi-three dimensional (Q3D) finite element techniques. The former analysis technique can be used to predict the total strain energy release rate, while the latter technique enables the calculation of the mixed-mode strain energy release rates. The Q3D analysis is very efficient since it produces a three-dimensional solution to a two-dimensional domain. A computer program was developed which generates PATRAN commands to generate the finite element model. PATRAN is a pre- and post-processor which is commonly used with a variety of finite element programs such as MCS/NASTRAN. The program creates a sufficiently dense mesh at the delamination crack tips to support a mixed-mode fracture mechanics analysis. The program

creates a coarse mesh in those regions where the gradients in the stress field are low (away from the delamination regions). A transition mesh is defined between these regions. This program is capable of generating a mesh for an arbitrarily oriented matrix crack. This program significantly reduces the modeling time required to generate these finite element meshes, thus providing a realistic tool with which to investigate the tension torsion problem.

Author

N91-13319*# Elizabeth City State Univ., NC. Dept. of Mathematics and Computer Science.

A THREE-DIMENSIONAL APPLICATION WITH THE NUMERICAL GRID GENERATION CODE: EAGLE (UTILIZING AN EXTERNALLY GENERATED SURFACE) **c61**

Johnny L. Houston *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 60-61 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 09B

Program EAGLE (Eglin Arbitrary Geometry Implicit Euler) is a multiblock grid generation and steady-state flow solver system. This system combines a boundary conforming surface generation, a composite block structure grid generation scheme, and a multiblock implicit Euler flow solver algorithm. The three codes are intended to be used sequentially from the definition of the configuration under study to the flow solution about the configuration. EAGLE was specifically designed to aid in the analysis of both freestream and interference flow field configurations. These configurations can be comprised of single or multiple bodies ranging from simple axisymmetric airframes to complex aircraft shapes with external weapons. Each body can be arbitrarily shaped with or without multiple lifting surfaces. Program EAGLE is written to compile and execute efficiently on any CRAY machine with or without Solid State Disk (SSD) devices. Also, the code uses namelist inputs which are supported by all CRAY machines using the FORTRAN Compiler CF177. The use of namelist inputs makes it easier for the user to understand the inputs and to operate Program EAGLE. Recently, the Code was modified to operate on other computers, especially the Sun Spare4 Workstation. Several two-dimensional grid configurations were completely and successfully developed using EAGLE. Currently, EAGLE is being used for three-dimension grid applications.

Author

N91-13320*# Hampton Univ., VA. Dept. of Mathematics.

A STUDY OF THE APPLICABILITY OF GALLIUM ARSENIDE AND SILICON CARBIDE AS AEROSPACE SENSOR MATERIALS **c76**

John S. Hurley *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 62-63 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 20L

Most of the piezoresistive sensors, to date, are made of silicon and germanium. Unfortunately, such materials are severly restricted in high temperature environments. By comparing the effects of temperature on the impurity concentrations and piezoresistive coefficients of silicon, gallium arsenide, and silicon carbide, it is being determined if gallium arsenide and silicon carbide are better suited materials for piezoresistive sensors in high temperature environments. The results show that the melting point for gallium arsenide prevents it from solely being used in high temperature situations, however, when used in the alloy Al(x)Ga(1-x)As, not only the advantage of the wider energy band gas is obtained, but also the higher desire melting temperature. Silicon carbide, with its wide energy band gap and higher melting temperature suggests promise as a high temperature piezoresistive sensor. Author

N91-13321*# Auburn Univ., AL. Dept. of Materials Science and Engineering.

PLASTIC DEFORMATION MECHANISMS IN POLYIMIDE RESINS AND THEIR SEMI-INTERPENETRATING NETWORKS **c27**

Bor Z. Jang *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 64-65 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 11C

High-performance thermoset resins and composites are critical to the future growth of space, aircraft, and defense industries in the USA. However, the processing-structure-property relationships in these materials remain poorly understood. In the present ASEE/NASA Summer Research Program, the plastic deformation modes and toughening mechanisms in single-phase and multiphase thermoset resins were investigated. Both thermoplastic and thermoset polyimide resins and their interpenetrating networks (IPNs and semi-IPNs) were included. The fundamental tendency to undergo strain localization (crazing and shear banding) as opposed to a more diffuse (or homogeneous) deformation in these polymers were evaluated. Other possible toughening mechanisms in multiphase thermoset resins were also examined. The topological features of network chain configuration/conformation and the multiplicity of phase morphology in INPs and semi-IPNs provide unprecedented opportunities for studying the toughening mechanisms in multiphase thermoset polymers and their fiber composites. Author

N91-13322*# Mercer Univ., Macon, GA. Dept. of Electrical and Computer Engineering.

RADIOMETER SYSTEM REQUIREMENTS FOR MICROWAVE REMOTE SENSING FROM SATELLITES **c43**

Jeng-Nan Juang *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 66-68 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 14B

An area of increasing interest is the establishment of a significant research program in microwave remote sensing from satellites, particularly geosynchronous satellites. Due to the relatively small resolution cell sizes, a severe requirement is placed on beam efficiency specifications for the radiometer antenna. Geostationary satellite microwave radiometers could continuously monitor several important geophysical parameters over the world's oceans. These parameters include the columnar content of atmospheric liquid water (both cloud and rain) and water vapor, air temperature profiles, and possibly sea surface temperature. Two principle features of performance are of concern. The first is the ability of the radiometer system to resolve absolute temperatures with a very small absolute error, a capability that depends on radiometer system stability, on frequency bandwidth, and on footprint dwell time. The second is the ability of the radiometer to resolve changes in temperature from one resolution cell to the next when these temperatures are subject to wide variation over the overall field-of-view of the instrument. Both of these features are involved in the use of the radiometer data to construct high-resolution temperature maps with high absolute accuracy. Author

N91-13323*# Virginia Commonwealth Univ., Richmond. Dept. of Chemistry.

QUANTITATIVE ANALYSIS OF ICE FILMS BY NEAR-INFRARED SPECTROSCOPY **c16**

Joseph T. Keiser *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 69-70 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 22B

One of the outstanding problems in the Space Transportation System is the possibility of the ice buildup on the external fuel tank surface while it is mounted on the launch pad. During the T-2 hours (and holding) period, the frost/ice thickness on the external tank is monitored/measured. However, after the resumption of the countdown time, the tank surface can only be monitored remotely. Currently, remote sensing is done with a TV camera coupled to a thermal imaging device. This device is capable of identifying the presence of ice, especially if it is covered with a layer of frost. However, it has difficulty identifying transparent ice,

and, it is not capable of determining the thickness of ice in any case. Thus, there is a need for developing a technique for measuring the thickness of frost/ice on the tank surface during this two hour period before launch. The external tank surface is flooded with sunlight (natural or simulated) before launch. It may be possible, therefore, to analyze the diffuse reflection of sunlight from the external tank to determine the presence and thickness of ice. The purpose was to investigate the feasibility of this approach. A near-infrared spectrophotometer was used to record spectra of ice. It was determined that the optimum frequencies for monitoring the ice films were 1.03 and 1.255 microns. Author

N91-13324*# College of William and Mary, Williamsburg, VA. Dept. of Chemistry.

THE EFFECTS OF THE SPACE ENVIRONMENT ON TWO ARAMID MATERIALS **c27**

Richard L. Kiefer *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 71-72 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 11C

Two aramid fibers having closely related chemical structures were chosen for important roles in the first tether to be used to connect pairs of orbiting vehicles. The protective outer jackets of the tethers will consist of woven fibers of poly(m-phenylene isophthalamide), commercially available from du Pont as Nomex. A cylindrical sheath of woven Kevlar 29, whose principal constituent is poly(p-phenylene terephthalamide), will be the load-bearing component for the tethers. Orbiting tethers will be in a hostile environment in which short wavelength electromagnetic radiation and energetic charged particles degrade exposed organic materials. At lower orbiting altitudes atomic oxygen is an especially serious hazard. Studies on the effects of ultraviolet radiation and atomic oxygen on fibers and films of Kevlar and Nomex are in progress. In an experiment to simulate the effects of atomic oxygen in space, small tows of Kevlar and Nomex were mounted in a commercial ashing device filled with oxygen at low pressure. An RF discharge in the instrument dissociated the molecular oxygen producing a strongly oxidizing atmosphere containing O(3P)(sup 4). Erosion was measured in terms of mass loss. Kevlar films were exposed to UV radiation in an apparatus consisting of a small vacuum chamber, 23 cm in diameter, into which a mass spectrometer and a quartz window were incorporated. Samples were exposed under vacuum with a 1000 watt xenon-arc lamp. Volatile products could be monitored with the mass spectrometer during the exposures. Transmission infrared spectra were taken before and after exposure to monitor chemical changes in the films. Author

N91-13325*# College of William and Mary, Williamsburg, VA. Dept. of Mathematics.

MINIMIZING DISTORTION IN TRUSS STRUCTURES VIA TABU SEARCH **c18**

Rex K. Kincaid *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 73-74 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 22B

The shape control of large flexible space structures is of great interest to structural designers. A related problem is to seek ways to minimize the need for active controls by careful design and construction of the space structure. A tetrahedral truss structure that is used to support a precision segmented reflector or antenna surface is considered. The structure has a hexagonal platform and is characterized by the number of rings of members in the truss. For simplicity it is assumed that a flat truss geometry exists. Hence, all structural members and ball joints are required to have the same nominal length and diameter, respectively. Inaccuracies in the length of member or diameters of joints may produce unacceptable levels of surface distortion and internal forces. In the case of a truss structure supporting an antenna, surface distortions may cause unacceptable gain loss or pointing errors. The focus is solely on surface distortion, however, internal forces may be treated in a similar manner. To test the Tabu search code for DSQRMS the appropriate influence matrices are used for a flat, two-ring tetrahedral reflector truss generated by Green and Hafika (1989). In this example there are 102 members (NMEMB) and 31 ball joints (NJOINT) of the same nominal length, respectively. Hence, all the members may be interchanged and all the joints may be interchanged. In addition, 19 positions on the surface of the truss (NNODES) were used to measure error influences. After a variety of experiments a set of good parameters was choosen for Tabu search. The sample size at each iteration is 10*NMEMB and the short term memory size is 40. In addition four pruning rules were used to accelerate the search.. Author

N91-13326*# Elizabeth City State Univ., NC. Dept. of Technology.

A USER-FRIENDLY MENU-DRIVEN LANGUAGE-FREE LASER CHARACTERISTICS CURVES GRAPHING PROGRAM **c61**

Glenn Klutz *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 75-76 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 09B

In the selection of laser materials to be used as active sensors, it is essential to know how various factors of the specific material composition interact. Questions such as how does the rod size and frequency or absorption relate and how might this be affected by temperature variations must be answered before the materials are selected. A menu-driven language-free program was developed that would graph the interrelationship of many physical parameters of laser materials. This program reduced or removed the requirement that all users be competent in FORTRAN. A menu-driven language-free program was then developed that requires the use of a microcomputer to graph a two-dimensional display of data. The ability to graph more than one graph-line on the same chart was accomplished. The program is now generic in that it will take any data file whether in the data base or not. The program generates the format for the data read statement if it is not contained in the file header and the user does not know how to write them. B.G.

N91-13327*# Pennsylvania State Univ., University Park. Dept. of Engineering Science and Mechanics.

MICROCRACKING MECHANISMS AND INTERFACE TOUGHENING OF SEMI-IPN POLYIMIDE MATRIX COMPOSITES **c24**

Byung L. Lee and R. Pater *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 77-78 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 11D

A new research program was initiated as a preliminary phase. The following three objectives are being pursued for the overall program: to elucidate the mechanisms of microcracking for graphite fiber-reinforced semi-IPN polyimide matrix composites under mechanical and thermal cyclic loading; to devise material engineering solutions for possible improvement of fatigue damage resistance (or the increase of fatigue endurance strength) of semi-IPN matrix composites by tailoring of modulus and toughness of fiber-resin interface region; and to assess processing characteristics of the composites and their roles in controlling the resistance of composites to microcracking and the effectiveness of interface toughening. The main emphasis was placed upon the initial screening of material systems and optimization of processing conditions for semi-IPN matrix composites with tailored interface. As a first set of control material systems to study, the composites were prepared with unsized Celion 6000 graphite fiber reinforcement and the following resin matrices of varied fracture toughness: PMR-15 thermoset polyimide, semi-IPN of PNR-15 thermoset polyimide and NR150B2 thermoplastic polyimide in 75/25 ratio, and semi-IPN of PMR-15 and NR150B2 in 50/50 ratio. For the composites with the resin matrix of semi-IPN in 75/25 ratio, interface tailoring was attempted by using graphite fibers coated with the resins of systematically varied fracture toughness. In the continuing work, a broad range of interlayer

toughness will be achieved by coating the fibers with reactants of semi-IPN having lower or higher content of thermoplastic constituent in comparison with the composition of surrounding resin matrix. In pursuing the objectives of the overall research program, the respective roles and interaction of critical parameters were defined. Author

N91-13328*# Montclair State Coll., Upper Montclair, NJ. Dept. of Psychology.

OPERATIONAL TESTING OF A FIGURE OF MERIT FOR OVERALL TASK PERFORMANCE c53

Moira LeMay *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 79-80 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 05I

An overall indicator or figure of merit (FOM), for the quality of pilot performance is needed to define optimal workload levels, predict system failure, measure the impact of new automation in the cockpit, and define the relative contributions of subtasks to overall task performance. A normative FOM was developed based on the calculation of a standard score for each component of a complex task. It reflected some effects, detailed in an earlier study, of the introduction of new data link technology into the cockpit. Since the technique showed promise, further testing was done. A new set of data was obtained using the recently developed Multi-Attribute Task Battery. This is a complex battery consisting of four tasks which can be varied in task demand, and on which performance measures can be obtained. This battery was presented to 12 subjects in a 20 minute trial at each of three levels of workload or task demand, and performance measures collected on all four tasks. The NASA-TLX workload rating scale was presented at minutes 6, 12, and 18, of each trial. A figure of merit was then obtained for each run of the battery by calculating a mean, SD, and standard score for each task. Each task contributed its own proportion to the overall FOM, and relative contributions changed with increasing workload. Thus, the FOM shows the effect of task changes, not only on the individual task that is changed, but also on the performance of other tasks and of the whole task. The cost to other tasks of maintaining constant performance on an individual task can be quantified. Author

N91-13329*# Old Dominion Univ., Norfolk, VA. Dept. of Psychology.

A FUTURE PERSPECTIVE ON TECHNOLOGICAL OBSOLESCENCEAT NASA, LANGLEY RESEARCH CENTER c81

Robert M. McIntyre *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 84-85 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 05A

The present research effort was the first phase of a study to forecast whether technological obsolescence will be a problem for the engineers, scientists, and technicians at NASA Langley Research Center (LaRC). There were four goals of the research: to review the literature on technological obsolescence; to determine through interviews of division chiefs and branch heads Langley's perspective on future technological obsolescence; to begin making contacts with outside industries to find out how they view the possibility of technological obsolescence; and to make preliminary recommendations for dealing with the problem. A complete description of the findings of this research can be reviewed in a technical report in preparation. The following are a small subset of the key findings of the study: NASA's centers and divisions vary in their missions and because of this, in their capability to control obsolescence; research-oriented organizations within NASA are believed by respondents to keep up to date more than the project-oriented organizations; asked what are the signs of a professional's technological obsolescence, respondents had a variety of responses; top performing scientists were viewed as continuous learners, keeping up to date by a variety of means; when asked what incentives were available to aerospace technologists for keeping up to data, respondents specified a number of ideas; respondents identified many obstacles to professionals' keeping up to date in the future; and most respondents expressed some concern for the future of the professionals at NASA vis a vis the issue of professional obsolescence. Author

N91-13330*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.

THE SEMIDISCRETE GALERKIN FINITE ELEMENT MODELING OF COMPRESSIBLE VISCOUS FLOW PAST AN AIRFOIL c02

Andrew J. Meade *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 86-87 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 01A

The primary project was the numerical simulation, by a finite element/finite difference method, of the viscous flow about an airfoil. The secondary project involved the numerical simulation of the three-dimensional separated and vortex-dominated flow about a hemispherically capped cylinder in the transonic regime. Preliminary calculations were started for the hemisphere-cylinder at 0 and 5 degree angle of attack. The solution of the flow field about airfoils and wings is required to determine the important parameters of lift, moment, and drag. Viscous effects must be accounted for if the drag is to be accurately calculated. At present there are basically two approaches to the numerical simulation of the flow field, the use of fully viscous models and the inviscid/viscous models. The fully viscous models require the solution of an approximation of the Navier-Stokes equations and therefore should simulate most of the physical mechanisms. A fast, accurate, and computationally efficient inviscid flow solver was recently developed by Hartwich. It is thought that Hartwich's program coupled to a fast, accurate, and computationally efficient boundary layer code, will make an excellent tool for airfoil design. The purpose of the primary project was to develop a compressible boundary layer code using the semidiscrete Galerkin finite element method. The numerical scheme employed used the combination of a Dorodnitsyn formulation of the boundary layer equations, with a finite difference/finite element procedure (semidiscrete Galerkin method), in the solution of the compressible two-dimensional boundary layer equations. A laminar compressible boundary layer code was developed and tested for a NACA 0012 airfoil at a Mach number of 0.5, a Reynolds number of 5000, and zero angle of attack. At present the boundary layer program solves up to, but not beyond, separation. Author

N91-13331*# Wichita State Univ., KS. Dept. of Aerospace Engineering.

AERODYNAMICS SUPPORT OF RESEARCH INSTRUMENT DEVELOPMENT c35

L. Scott Miller *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 88-89 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 14B

A new velocimetry system is currently being developed at NASA LaRC. The device, known as a Doppler global velocimeter (DGV), can record three velocity components within a plane simultaneously and in near real time. To make measurements the DGV, like many other velocimetry systems, relies on the scattering of light from numerous small particles in a flow field. The particles or seeds are illuminated by a sheet of laser light and viewed by two CCD cameras. The scattered light from the particles will have a frequency which is a function of the source laser light frequency, the viewing angle, and most importantly the seed velocities. By determining the scattered light intensity the velocity can be measured at all points within the light sheet simultaneously. Upon completion of DGV component construction and initial check out a series of tests in the Basic Aerodynamic Research (wind) Tunnel (BART) are scheduled to verify instrument operation and accuracy. If the results are satisfactory, application of the DGV to flight measurements on the F-18 High Alpha Research Vehicle (HARV)

are planned. The DGV verification test in the BART facility will utilize a 75 degree swept delta wing model. A major task undertaken this summer included evaluation of previous results for this model. A specific series of tests matching exactly the previous tests and exploring new DGV capabilities were developed and suggested. Another task undertaken was to study DGV system installation possibilities in the F-18 HARV aircraft. In addition, a simple seeding system modification was developed and utilized to make Particle Imaging Velocimetry (PIV) measurements in the BART facility. Author

N91-13332*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.

PARALLEL-VECTOR COMPUTATION FOR CSI-DESIGN CODE Abstract Only **c61**

Duc T. Nguyen *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 90 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 09B

Computational aspects of Control-Structure Interaction (CSI) DESIGN code is reviewed. Numerical intensive computation portions of CSI-DESIGN code were identified. Improvements in computational speed for the CSI-DESIGN code can be achieved by exploiting parallel and vector capabilities offered by modern computers, such as the Alliant, Convex, Cray-2, and Cray-YMP. Four options to generate the coefficient stiffness matrix and to solve the system of linear, simultaneous equations are currently available in the CSI-DESIGN code. A preprocessor to use RCM (Reverse Cuthill-Mackee) algorithm for bandwidth minimization was also developed for the CSI-DESIGN code. Preliminary results obtained by solving a small-scale, 97 node CSI finite element model (for eigensolution) have indicated that this new CSI-DESIGN code is 5 to 6 times faster (using 1 Alliant processor) than the old version of CSI-DESIGN code. This speed-up was achieved due to the RCM algorithm and the use of a new skyline solver. Efforts are underway to further improve the vector speed for CSI-DESIGN code, to evaluate its performance on a larger scale CSI model (such as phase zero CSI model) to make the code run efficiently on multiprocessor, parallel computer environment, and to make the code portable among different parallel computers available at NASA LaRC, such as Alliant, Convex, and Cray computers. Author

N91-13333*# Military Academy, West Point, NY. Dept. of Aerospace Engineering.

CALCULATION OF ROTOR IMPEDANCE FOR USE IN DESIGN ANALYSIS OF HELICOPTER AIRFRAME VIBRATIONS **c05**

Kip P. Nygren *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 91-92 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 01C

Excessive vibration is one of the most prevalent technical obstacles encountered in the development of new rotorcraft. The inability to predict these vibrations is primarily due to deficiencies in analysis and simulation tools. The Langley Rotorcraft Structural Dynamics Program was instituted in 1984 to meet long term industry needs in the area of rotorcraft vibration prediction. As a part of the Langley program, this research endeavors to develop an efficient means of coupling the rotor to the airframe for preliminary design analysis of helicopter airframe vibrations. The main effort was to modify the existing computer program for modeling the dynamic and aerodynamic behavior of rotorcraft called DYSCO (DYnamic System COupler) to calculate the rotor impedance. DYSCO was recently developed for the U.S. Army and has proven to be adaptable for the inclusion of new solution methods. The solution procedure developed to use DYSCO for the calculation of rotor impedance is presented. Verification of the procedure by comparison with a known solution for a simple wind turbine model is about 75 percent completed, and initial results are encouraging. After the wind turbine impedance is confirmed, the verification effort will continue by comparison to solutions of a more sophisticated rotorcraft model. Future work includes determination of the sensitivity of the rotorcraft airframe vibrations to helicopter flight conditions and rotor modeling assumptions. When completed, this research will ascertain the feasibility and efficiency of the impedance matching method of rotor-airframe coupling for use in the analysis of airframe vibrations during the preliminary rotorcraft design process. Author

N91-13334*# College of William and Mary, Williamsburg, VA. Dept. of Chemistry.

ADDITIVES TO REDUCE SUSCEPTIBILITY OF THERMOSETS AND THERMOPLASTICS TO EROSION FROM ATOMIC OXYGEN **c27**

Robert A. Orwoll *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 93-94 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 11C

Polymeric materials have many attractive features such as light weight, high strength, and broad applicability in the form of films, fibers, and molded objects. In low earth orbit (LEO), these materials, when exposed on the exterior of the spacecraft, have the serious disadvantage of being susceptible to erosion by atomic oxygen (AO). AO is the most common chemical species at LEO altitudes. AO can be an extremely efficient oxidizing agent as was apparent from the extensive erosion of organic films exposed in STS missions. The mechanism for erosion involves the reaction of oxygen atoms at the surface of the substrate to form small molecular species. The susceptibility of polymeric materials varies with their chemical composition. Films with silicon atoms incorporated in the molecular structures have large coefficients of thermal expansion. This limits their utility. In an alternative approach additives were sought that mix physically and form a protective oxide layer when the film is exposed to AO. A large number of organic compounds containing silicon, germanium, or tin atoms were screened. Most were found to have very limited solubility in the polyetherimide (Ultem) films that were being protected from AO. However, one, bis(triphenyl tin) oxide, (BTO), is miscible in Ultem up to about 25 percent. Films of Ultem polyimide containing up to 25 wt percent BTO were prepared by evaporation of solvent from a solution of Ultem and BTO. The effects of AO on these films were simulated in the oxygen atmosphere of a radio frequency glow-discharge chamber. In the second part of this study, atoms were incorporated in epoxy resins. Experiments are in progress to measure the resistance of films of the cured epoxy to AO in the discharge chamber. Author

N91-13335*# Hampton Univ., VA. Dept. of Physics.

A MODIFIED PUMP LASER SYSTEM TO PUMP THE TITANIUM SAPPHIRE LASER Abstract Only **c36**

Larry B. Petway *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 95 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 11F

As a result of the wide tunability of the titanium sapphire laser NASA has sited it to be used to perform differential absorption lidar (DIAL) measurements of H2O vapor in the upper and lower troposphere. The titanium sapphire laser can provide a spectrally narrow (0.3 to 1.0 pm), high energy (0.5 to 1.0 J) output at 727, 762, and 940 nm which are needed in the DIAL experiments. This laser performance can be obtained by addressing the line-narrowing issues in a master oscillator and the high energy requirement in a fundamental mode oscillator. By injection seeding, the single frequency property of the master oscillator can produce a line narrow high energy power oscillator. A breadboard model of the titanium sapphire laser that will ultimately be used in NASA lidar atmospheric sensing experiment is being designed. The task was to identify and solve any problem that would arise in the actual laser system. One such problem was encountered in the pump laser system. The pump laser that is designed to pump both the master oscillator and power oscillator is a Nd:YLF laser. Nd:YLF exhibits a number of properties which renders this material an attractive option to be used in the laser system. The Nd:YLF

crystal is effectively athermal; it produces essentially no thermal lensing and thermally induced birefringence is generally insignificant in comparison to the material birefringence resulting from the uniaxial crystal structure. However, in application repeated fracturing of these laser rods was experience. Because Nd:YLF rods are not commercially available at the sizes needed for this application a modified pump laser system to replace the Nd:YLF laser rod was designed to include the more durable Nd:YAG laser rods. In this design, compensation for the thermal lensing effect that is introduced because of the Nd:YAG laser rods is included. Author

N91-13336*# University of Western Carolina, Cullowhee, NC.
ANALYSIS OF PRESSURE-BROADENED OZONE SPECTRA IN THE 3 MICRON REGION **c45**
Eleanor S. Prochaska *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 96-99 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 13B

The Molecular Spectroscopy Lab at NASA-Langley has been involved in a long term effort to carefully characterize the infrared spectra of small molecules of atmospheric interest, including methane, water vapor, ozone, and their isotopic counterparts. High resolution gas phase infrared spectra are obtained using both a tunable diode laser system, and the McMath Fourier transform spectrometer at the Kitt Peak Solar Observatory. Spectra are obtained at various pressures and temperatures for pure gas samples, and for samples containing mixtures of the species of interest in nitrogen, oxygen, or air. From these spectra, using a nonlinear least squares fitting technique, spectral parameters of position, intensity, and half-width were determined for varying laboratory conditions that approximate atmospheric conditions experienced in remote sensing situations. These parameters are of interest in theoretical studies of these species, as well as in allowing more accurate interpretation of remote sensing data. The current work involves the analysis of a series of McMath FTIR spectra of ozone broadened by mixing with air, nitrogen, or oxygen. Each spectrum covers the region from 2396 to 4057/cm. Each vibrational band is analyzed by first diving its region into small intervals containing a few well isolated absorption lines of reasonable intensity. Each of these small intervals is fit by multiple iterations of the nonlinear least square program until residuals are minimized to a reasonable value which corresponds to the noise level of the measured spectrum. Intervals for the 3 nu(sub 3) ozone band in the region from 3000 to 3060 wavenumbers are being examined. Author

N91-13337*# City Univ. of New York, NY. Dept. of Mechanical Engineering.
SIMULATION OF ROTATION EFFECT IN TURBULENCE DISSIPATION RATE EQUATION Abstract Only **c34**
Rishi S. Raj *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 100 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20D

It was observed that the Reynolds stress transport equations using the usual isotropic dissipation rate transport equations do not accurately predict the correct evolution of the kinetic energy in both homogeneous shear and isotropic decay. This same effect carries over to more practical flows such as those with strong irrotational strains and/or adverse pressure gradients. The deficiencies in these predictions were attributed to the need for modifications in the isotropic dissipation rate equation. Pope and Hanjalic and Launder have proposed modifications to this equation. These modifications were tested in the cases of homogeneous shear and iso-decay and their performance was analyzed. The results are compared to the rotating flow models of Bardina and Raj. Author

N91-13338*# Christian Brothers Coll., Memphis, TN. Dept. of Chemical Engineering.
FINE-TUNING OF PROCESS CONDITIONS TO IMPROVE PRODUCT UNIFORMITY OF POLYSTYRENE PARTICLES USED FOR WIND TUNNEL VELOCIMETRY **c09**
Asit K. Ray *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 101-103 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 14B

Monodisperse polymer particles (having uniform diameter) were used for the last two decades in physical, biological, and chemical sciences. In NASA Langley Research Center monodisperse polystyrene particles are used in wind tunnel laser velocimeters. These polystyrene (PS) particles in latex form were formulated at the Engineering Laboratory of FENGD using emulsion-free emulsion polymerization. Monodisperse PS latices particles having different particle diameters were formulated and useful experimental data involving effects of process conditions on particle size were accumulated. However, similar process conditions and chemical recipes for polymerization of styrene monomer have often yielded monodisperse particles having varying diameters. The purpose was to improve the PS latex product uniformity by fine-tuning the process parameters based on the knowledge of suspension and emulsion polymerization. Author

N91-13339*# College of Southern Georgia, Statesboro. Dept. of Mathematics and Computer Science.
A RATE EQUATION APPROACH TO GAIN SATURATION EFFECTS IN LASER MODE CALCULATIONS **c36**
Lila F. Roberts *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 104-106 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20E

Space exploration and research require large amounts of power. Solar pumped laser systems have been shown to have the potential for meeting the performance requirements necessary for power transmission in space. The successful design of laser systems for these applications will depend, in part, on having a clear understanding of the development of the dynamical processes in the laser cavity and on the effects that changes in physical and design parameters have on laser performance. In particular, it is necessary to know the amplitude and phase distributions of the laser beam at the output aperture when steady state operation is achieved in order to determine the far-field power distribution. The output from the laser will depend on the active medium, the optical environment of the active material and on the gain distribution in the active region as laser action builds up and reaches steady state. An important component in the design process will be a realistic model of the active laser cavity. A computer model of the laser cavity, based on Huygens' principle was developed. The code calculates the amplitude and phase of an optical wave reflected back and forth between the mirrors of a laser cavity. The original code assumes a gain distribution which does not change with the buildup of oscillations in the cavity. A step in the direction of realism is the inclusion of a saturable gain medium in the cavity. The objective is to incorporate saturation effects into the existing computer model. Author

N91-13340*# Virginia Commonwealth Univ., Richmond. Dept. of Mathematical Sciences.
FACILITATING RESEARCHER USE OF FLIGHT SIMULATORS **c09**
C. Ray Russell *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 107-109 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 14B

Researchers conducting experiments with flight simulators encounter numerous obstacles in bringing their ideas to the simulator. Research into how these simulators could be used more efficiently is presented. The study involved: (1) analyzing the

Advanced Concepts Simulator software architecture, (2) analyzing the interaction between the researchers and simulation programmers, and (3) proposing a documentation tool for the researchers. Author

N91-13341*# Florida Inst. of Tech., Melbourne. Dept. of Mechanical and Aerospace Engineering.

COMPUTATIONAL ANALYSIS OF FLOW IN 3D PROPULSIVE TRANSITION DUCTS **c34**

Paavo Sepri *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 110-112 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 20D

A numerical analysis of fully three dimensional, statistically steady flows in propulsive transition ducts being considered for use in future aircraft of higher maneuverability is investigated. The purpose of the transition duct is to convert axisymmetric flow from conventional propulsion systems to that of a rectangular geometry of high aspect ratio. In an optimal design, the transition duct would be of minimal length in order to reduce the weight penalty, while the geometrical change would be gradual enough to avoid detrimental flow perturbations. Recent experiments conducted at the Propulsion Aerodynamics Branch have indicated that thrust losses in ducts of superelliptic cross-section can be surprisingly low, even if flow separation occurs near the divergent walls. In order to address the objective of developing a rational design procedure for optimal transition ducts, it is necessary to have available a reliable computational tool for the analysis of flows achieved in a sequence of configurations. Current CFD efforts involving complicated geometries usually must contend with two separate but interactive aspects: namely, grid generation and flow solution. The first two avenues of the present investigation were comprised of suitable grid generation for a class of transition ducts of superelliptic cross-section, and the subsequent application of the flow solver PAB3D to this geometry. The code, PAB3D, was developed as a comprehensive tool for the solution of both internal and external high speed flows. The third avenue of investigation has involved analytical formulations to aid in the understanding of the nature of duct flows, and also to provide a basis of comparison for subsequent numerical solutions. Numerical results to date include the generation of two preliminary grid systems for duct flows, and the initial application of PAB3D to the corresponding geometries, which are of the class tested experimentally. Author

N91-13342*# West Virginia Univ., Morgantown. Dept. of Electrical and Computer Engineering.

REDUCED-ORDER FILTERING FOR FLEXIBLE SPACE STRUCTURES **c18**

Craig S. Sims *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 113-114 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 22B

There is a need for feedback control of the large flexible space structures which are going to be increasingly important in the future of the space program. These structures are very lightly damped, and vibrations may persist for a long time when the system is disturbed unless an active feedback control strategy is used to damp out the vibrations. The system is best described by a partial differential equation description, but the more common approach is to use a large set of second order differential equations, where a large number of modes must be retained if the mathematics is to provide an adequate description of the dynamical process. Sensors, such as accelerometers and rate gyros, may provide data to the feedback controller so that it may respond appropriately to control the system. The data from the sensors is not perfect, but is subject to noise, called measurement noise, and the dynamical process itself is subject to disturbances referred to as process noise. Filtering the sensor signals to remove the measurement noise, and using the resulting state estimates to control the system are investigated. Author

N91-13343*# Northeastern Univ., Boston, MA. Dept. of Computer Systems Engineering.

IMPROVING SYSTEM RELIABILITY THROUGH FORMAL ANALYSIS AND USE OF CHECKS IN SOFTWARE **c61**

Mark E. Staknis *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 115-116 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 09B

Software is playing increasingly important roles in avionics systems. It is widely used in navigation and, in some cases, in control loops that maintain aircraft stability. To guarantee the safety of flight systems, the FAA requires that critical components have a probability of failure no greater than 10(exp -9) per hour of flight. Software is being used to diagnose system components for failure. SIFT (Software Implemented Fault Tolerance) was a computer system developed to study the use of software to check for failure and manage processor reconfiguration. To guarantee that software satisfies its specifications, formal verification can be used. With this a program and its specification are viewed as mathematical objects, and a mathematical proof is used to show that the program and its specification are equivalent. In previous research, a theory of checking was developed to offer assistance in analyzing specifications and designing run-time checks. In the theory, checking is considered abstractly in terms of n-ary relations much like those of relational database theory. Within the theory check are categorized, checks on input and checks on results are considered, and formal attention is given to the minimization and logical combination of checks. The focus is upon input checks and the obstacles in checking input to critical systems. A central concern is with a property referred to as independence. The concern is with circumstances under which it is possible to apply isolated, independent checks to separate sensor inputs and be assure that all illegal input will be properly detected. Presently, independence is being investigated and checked in the context of the GCS (Guidance and Control System). The GCS simulator is intended for testing software that implements control laws for landing spacecraft. The large number of inputs and their complex interrelationships provide an exciting context in which to investigate independence and the difficulties of supplying input checks. Author

N91-13344*# Old Dominion Univ., Norfolk, VA. Dept. of Engineering Management.

DESIGN OPTIMIZATION FOR COST AND QUALITY: THE ROBUST DESIGN APPROACH **c38**

Resit Unal *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 117-118 (For primary document see N91-13309 04-80)

Avail: NTIS HC/MF A07 CSCL 14D

Designing reliable, low cost, and operable space systems has become the key to future space operations. Designing high quality space systems at low cost is an economic and technological challenge to the designer. A systematic and efficient way to meet this challenge is a new method of design optimization for performance, quality, and cost, called Robust Design. Robust Design is an approach for design optimization. It consists of: making system performance insensitive to material and subsystem variation, thus allowing the use of less costly materials and components; making designs less sensitive to the variations in the operating environment, thus improving reliability and reducing operating costs; and using a new structured development process so that engineering time is used most productively. The objective in Robust Design is to select the best combination of controllable design parameters so that the system is most robust to uncontrollable noise factors. The robust design methodology uses a mathematical tool called an orthogonal array, from design of experiments theory, to study a large number of decision variables with a significantly small number of experiments. Robust design also uses a statistical measure of performance, called a signal-to-noise ratio, from electrical control theory, to evaluate the level of performance and the effect of noise factors. The purpose

is to investigate the Robust Design methodology for improving quality and cost, demonstrate its application by the use of an example, and suggest its use as an integral part of space system design process. Author

N91-13345*# Duke Univ., Durham, NC. Dept. of Electrical Engineering.
DESIGN OF QMF (QUADRATURE MIRROR FILTER) IN SPATIAL DOMAIN AND EDGE ENCODING c33
Paul P. Wang *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 119-122 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 09C

Simoncelli and Adelson have extended the one dimensional Quadrature Mirror Filter (QMF) to two dimensions with hexagon symmetry and three dimensional spatio-temporal extensions with rhombic-duodecahedray symmetry. Jain and Crochiere presented an excellent QMF design technique in the time domain. It is proposed to extend the design of a two dimensional QMF over a rectangular lattice in the spatial domain based primarily on the extension of the idea of Jain and Crochiere. In addition, the design will investigate the use of two dimensional Z-transformations. Since this proposed QMF is intended for the applications in image processing, all the important and interesting engineering issues will be addressed throughout the development phase. The design of a two dimensional QMF is discussed. The motivation is to achieve an extremely high data compression ratio. It is entirely possible to achieve dramatic results when pattern recognition techniques are employed. The final goal is the demonstration of extremely high data compression ratios using NASA pictures. Author

N91-13346*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
ANALYSES OF COMPOSITE FUSELAGE STRUCTURE UNDER VARIOUS LOADING CONDITIONS c39
Fuh-Gwo Yuan *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 123-125 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 20K

With the characteristics of high strength/weight and stiffness/weight ratios in advanced composite materials, composite plate structures have been successfully applied to secondary load-carrying structural components in the aerospace industry for the past two decades. Recently, filament wound composite shells are being considered for design of primary fuselage structures. To implement the design the structural response under various loading conditions needs to be predicted accurately. Therefore, it is essential to establish a rigorous analytical solution in the area of composite laminated shells. A closed form solution is presented that predicts the response of a composite shell subjected to internal pressure, axial tension, bending, and torsion. The material of the shell is assumed to be general cylindrically anisotropic. Based on the theory of cylindrical anisotropic elasticity coupled partial differential governing equations are developed using Lehknitskii's stress function approach. The general expressions for the stresses and displacements in the composite cylinders under these loading conditions is discussed. Three examples (45) off-axis unidirectional, (45/45) unsymmetric, and (45/45)(sub s) symmetric angle-ply fiber-reinforced laminated shells are shown to illustrate the effect of radius-to-thickness ratios, coupling, and stacking sequence. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N91-13347*# National Aeronautics and Space Administration, Washington, DC.
ISSUES IN NASA PROGRAM AND PROJECT MANAGEMENT
Francis T. Hoban, ed. Jul. 1990 57 p
(NASA-SP-6101(03); NAS 1.21:6101(03)) Avail: NTIS HC/MF A04 CSCL 05A

This volume is the third in an ongoing series on aerospace project management at NASA. Articles in this volume cover the attitude of the program manager, program control and performance measurement, risk management, cost plus award fee contracting, lessons learned from the development of the Far Infrared Absolute Spectrometer (FIRAS), small projects management, and age distribution of NASA scientists and engineers. A section on resources for NASA managers rounds out the publication. Author

N91-13348*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
SPACE MARKET MODEL DEVELOPMENT PROJECT, PHASE 3
Peter C. Bishop and Gary P. Hamel Jun. 1989 67 p
(Contract NCC9-16)
(NASA-CR-187251; NAS 1.26:187251) Avail: NTIS HC/MF A04 CSCL 05A

The results of a research project investigating information needs for space commercialization is described. The Space Market Model Development Project (SMMDP) was designed to help NASA identify the information needs of the business community and to explore means to meet those needs. The activity of the SMMDP is reviewed and a report of its operation via three sections is presented. The first part contains a brief historical review of the project since inception. The next part reports results of Phase 3, the most recent stage of activity. Finally, overall conclusions and observations based on the SMMDP research results are presented. Author

N91-13349*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
SPACE MARKET MODEL DEVELOPMENT PROJECT, PHASE 2
Peter C. Bishop Jun. 1988 41 p
(Contract NCC9-16)
(NASA-CR-187250; NAS 1.26:187250) Avail: NTIS HC/MF A03 CSCL 05A

The results of the prototype operations of the Space Business Information Center are presented. A clearinghouse for space business information for members of the U.S. space industry composed of public, private, and academic sectors was conducted. Behavioral and evaluation statistics were recorded from the clearinghouse and the conclusions from these statistics are presented. Business guidebooks on major markets in space business are discussed. Proprietary research and briefings for firms and agencies in the space industry are also discussed. Author

N91-13350*# National Aeronautics and Space Administration, Washington, DC.
[SUMMARY DATA ON ALL NASA PROCUREMENT ACTIONS] Semiannual Procurement Report, FY 1 Oct. 1989 - 31 Mar. 1990
1990 30 p
(NASA-TM-103447; NAS 1.15:103447) Avail: NTIS HC/MF A03 CSCL 05A

Summary data on all NASA procurement actions and detailed information on contracts, grants, agreements, and other procurements over $25,000 awarded by NASA during the first six months on fiscal year 1990 are presented. Areas addressed include competition in NASA awards, awards to business firms, awards to educational and other nonprofit institutions, contract for operation of Jet Propulsion Laboratory, and awards through other government

agencies. Other topics covered are the U.S. geographical distribution of awards, awards placed outside the U.S., and procurement activity by installation. Author

N91-13351# Klein Associates, Yellow Springs, OH.
INVESTIGATIONS OF NATURALISTIC DECISION MAKING AND THE RECOGNITION-PRIMED DECISION MODEL
Gary A. Klein and Roberta Calderwood Jul. 1990 61 p (Contract MDA903-85-C-0327)
(AD-A226006; KA-TR-88-02Z; ARI-RN-90-59) Avail: NTIS HC/MF A04 CSCL 05/8

This monograph reviews three years of research that explores how experienced personnel make decisions in operational settings characterized by real-time information processing, shifting goals, and high-risk consequences. The study combined field studies with experiments designed to test specific hypotheses. Study domains were selected so that findings would have high potential for generalizing to military command-and-control decision making. Researchers carried out critical decision interviews with experienced personnel, including urban fire ground commanders, wildland fire incident commanders, and U.S. Army tank platoon leaders. Interviews were designed to elicit information about the cues, goals, and option evaluation strategies used by these personnel. Based on these interviews, the relationships among such factors as time pressure, experience level, and group interactions were explored. The results of these studies have been used to develop a recognition-primed decision (RPD) model of decision making. This model contrasts with current normative and prescriptive models of decision making, and the implications of this alternative framework are explored. GRA

N91-12583# British Aerospace Public Ltd. Co., Hatfield (England).
DETERMINING TECHNOLOGY OBJECTIVES
J. B. Scott-Wilson *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 4 p (For primary document see N91-12579 04-01)
Copyright Avail: NTIS HC/MF A06; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-12584# Alabama Univ., Huntsville.
AERONAUTICAL COMPONENT RESEARCH
James J. Kramer *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 5 p (For primary document see N91-12579 04-01)
Copyright Avail: NTIS HC/MF A06; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-12585# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PLANNING APPLIED RESEARCH IN FRANCE
A. Auriol *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 16 p (For primary document see N91-12579 04-01)
Copyright Avail: NTIS HC/MF A06; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N91-12729# European Space Agency, Paris (France).
ESA INDUSTRIAL POLICY DATE AND TENDER PROCESS [INDUSTRIEPOLITISCHE VORGABEN UND AUSSCHREIBUNGSVERFAHREN DER ESA]
Winfried Thoma *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 65-80 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

N91-12730# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
NATIONAL GERMAN HANDLING OF SPACE TRAVEL PROJECTS AND ACCESS POSSIBILITIES TO SPACE TRAVEL TASKS [NATIONALE FOERDERUNG VON RAUMFAHRTVORHABEN UND MOEGLICHKEITEN DES ZUGANGS ZU RAUMFAHRTAUFGABEN]
Norbert Kiehne *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 85-94 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

N91-12731# INTOSPACE G.m.b.H., Hanover (Germany, F.R.).
INDUSTRIAL AND SCIENTIFIC APPLICATION OF SPACE TRAVEL [INDUSTRIELLE UND WISSENSCHAFTLICHE NUTZUNG DER RAUMFART]
Juergen vonderLippe *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 97-101 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

N91-12732# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
INDUSTRIAL AND SCIENTIFIC APPLICATION OF SPACE TRAVEL [INDUSTRIELLE UND WISSENSCHAFTLICHE NUTZUNG DER RAUMFAHRT]
Hans M. Kappler *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 103-121 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

N91-12733# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.).
TECHNOLOGICAL FIELDS AND PROFILES IN SPACE TRAVEL: PROSPECTS FOR SMALL AND MIDDLE SIZE COMPANIES [TECHNOLOGIEFELDER UND -PROFILE IN DER RAUMFAHRT: CHANCEN FUER KLEINE UND MITTLERE UNTERNEHMEN]
Ernst Hoegenauer *In* Deutscher Industire- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 127-139 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

N91-12735# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
EXPERIENCE-BASED REPORT OF A SYSTEM LEADER COMPANY [ERFAHRUNGSBERICHT EINER SYSTEMFUEHRUNGSFIRMA]
Manfred Hollstein *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 161-174 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

N91-12736# Von Hoerner und Sulger Electronic G.m.b.H., Schwetzingen (Germany, F.R.).
EXPERIENCE-BASED REPORT OF A SYSTEM LEADER COMPANY [ERFAHRUNGSBERICHT EINES RAUMFAHRTERFAHRENEN KLEINEN UNTERNEHMENS]
Hanna vonHoerner *In* Deutscher Industrie- und Handelstag, Space Travel Economics: Prospects for a Greater Participation of German Companies in Space Travel Research 1989 p 175-187 In GERMAN (For primary document see N91-12725 04-16)
Avail: NTIS HC/MF A11

N91-13329*# Old Dominion Univ., Norfolk, VA. Dept. of Psychology.
A FUTURE PERSPECTIVE ON TECHNOLOGICAL OBSOLESCENCEAT NASA, LANGLEY RESEARCH CENTER
Robert M. McIntyre *In* Hampton Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1990 Sep. 1990 p 84-85 (For primary document see N91-13309 04-80)
Avail: NTIS HC/MF A07 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N91-13352# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Technical Information Panel.

BENEFITS OF COMPUTER ASSISTED TRANSLATION TO INFORMATION MANAGERS AND END-USERS

Jun. 1990 148 p In ENGLISH and FRENCH Lecture series held in Washington, DC, 14-15 Jun. 1990; in Brussels, Belgium, 25-26 Jun. 1990; and in London, England, 28-29 Jun. 1990 (AGARD-LS-171; ISBN-92-835-0568-9) Copyright Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The aim of this Lecture Series is to show how computer assisted translation (CAT) can be of benefit not only to information managers but also to end-users. Existing systems are described as well as the nature of the texts to be processed, the technical and human problems related to the use of such systems and the needs of end-users (quality level of translations, information acquisition in the mother tongue...). Examples of on-going applications and systems under development are presented. These examples highlight the benefits documentation centers will derive from CAT and suggest solutions of interest to the end-user. For individual titles, see N91-13353 through N91-13361.

N91-13353# Commission of the European Communities (Luxembourg).

TYPOLOGY OF EXISTING SYSTEMS

Ian M. Pigott *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 5 p (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Various attempts were made at defining a typology of Machine Translation (MT) systems, some based on generations of software and hardware developments, others on the nature of the translation process (e.g., direct, transfer, modular). Today, however, a classification based more generally on performance and user access would appear to be more appropriate. Differentiation is made between large software packages installed on mainframe computers for access by telecommunications and smaller PC packages functioning on MS-DOS equipment. Attention is also given to systems capable of dealing with limited vocabulary and syntax as well as to developments in Japan which are beginning to set new trends in MT technology. Finally, information will be presented on how systems are now being used in practice and how use is likely to evolve over the next decade. Author

N91-13354# Centre de Documentation de l'Armement, Paris (France).

THE TECHNICAL ENVIRONMENT OF COMPUTER ASSISTED TRANSLATION [L'ENVIRONNEMENT TECHNIQUE DE LA TRADUCTION ASSISTEE PAR ORDINATEUR]

Albert Yanez *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 14 p In FRENCH (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Paradoxically, whereas enormous progress has been made in translation and interpretation, especially in the area of information technology, computer assisted translation seems to have set the pace, while at the same time in certain countries, it seems to be in regression. The main reason is that very often there are deplorable technical environments, especially in the areas of man-machine systems and human factors engineering. For clarity, the following outline is examined. The method in which a problem is posed: adjustment of the risk, different needs, and applications provided for different environments. The technical environment in the research and development phase, where a distinction is made between information and aspects which are related, on one hand, to linguistics, and on the other, to the stage leading to industrialization provided by a version of the product. The fragile and critical operational environment is clearly improvable. There is a need to integrate it in a particular application or a particular customer's case. That integration is possible if a certain number of conditions are met, especially in the case of translating. This can add to the system's operational life if human factors engineering, e.g., is used for sensible task reduction, so that energy is saved along with the responsibility of the final translation. The conclusion is in the form of a series of recommendations.

Transl. by E.R.

N91-13355# Department of the Secretary of State, Ottawa (Ontario).

TYPOLOGY TEST OF TEXT SOURCES IN THE FRAMEWORK OF COMPUTER AIDED TRANSLATION [ESSAI DE TYPOLOGIE DES TEXTES SOURCE, DANS LE CADRE DE LA TRADUCTION ASSISTEE PAR ORDINATEUR]

Jean Gordon *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 8 p In FRENCH; ENGLISH summary (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The question of whether or not to use computer-assisted translation requires serious thought. All factors must be taken into consideration. A typology helps to identify the category into which texts fall and the extent to which they lend themselves to this approach. The typology is based on material considerations (medium used and compatibility), terminological considerations (variety, complexity and stability of vocabulary) and stylistic considerations (presence of certain linguistic characteristics that affect the quality of results). This examination of the profile of documents is a sort of pre-screening tool. A thorough analysis should also be conducted before any final decision is taken.

Author

N91-13356# Aerospatiale, Toulouse (France). Aircraft Div.

PROBLEMS ENCOUNTERED WITH THE USE OF COMPUTER ASSISTED TRANSLATION IN A TECHNICAL PUBLICATIONS PRODUCTION ENVIRONMENT

D. J. Pinna *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 9 p (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A brief overview is given of the problems evidenced during studies into the use of Computer Assisted Translation (CAT) in the Aerospatiale Aircraft Division technical publications production environment. The aim is not to review the capabilities of the various CAT systems available in a comparative study but rather to highlight the technical, economical and psychological problems that have to date precluded the integration of CAT in this very specific industrial context. Author

N91-13357# Siemens A.G., Munich (Germany, F.R.).

END USERS' NEEDS

Thomas Schneider *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 5 p (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

To assure international communication the introduction of machine translation systems is unavoidable. To be of use in practical applications, however, a system must fulfill the criteria of operability defined by the end user. In this context, two different applications must be contrasted, namely automatic translation with the aim of gathering information for internal applications on one

hand and automatic translation with the aim of producing publications for external recipients on the other hand. In the first case, throughput and coverage of the system lexicon are most important while preservation of layout and format information are secondary. In the latter case, a much higher translation quality is required to ensure user acceptance. To be effective in an office environment, additional aspects become relevant: user interface, integration with other office systems, efficient lexicon update and post editing tools. Necessary for all types of applications is an intensive end user training and continuing support from specialist consultants. Author

N91-13358# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Technology Div.

ASPECTS OF MACHINE TRANSLATION IN THE UNITED STATES AIR FORCE

Dale A. Bostad *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 5 p (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Machine translation is used in the USAF to translate technical literature in a wide variety of disciplines to support studies that assess the capabilities and research of the Soviet Union and other countries. Two types of machine translation are used: partially edited machine translation with hard copy printing of the text; and raw machine translation for rapid information scanning of material at a terminal. A special software program is used for rapid post-editing of texts. Potential trouble spots and ambiguities are intercepted and corrections are made by post-editors. Raw machine translation for gisting large volumes of information has proven to be an effective tool for analysts and researchers. Statistics indicate an ever-increasing use of machine translation for rapid information scanning. Author

N91-13359# Siemens A.G., Munich (Germany, F.R.).

STATE OF THE ART IN WEST GERMANY

Thomas Schneider *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 12 p (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In Europe, research and development in the field of machine translation has been boosted by the EEC's EUROTRA program. However, operative systems are usually based on older technologies, as in SYSTRAN or LOGOS. In recent years, the METAL system designed by Siemens has proved its applicability. As it exemplies the state of the art it is described in detail. METAL is a modular system with recursive grammars and non-sequential processing. It contains hierarchically structured lexicon modules to facilitate subject-specific translation. The end-user is provided with powerful tools to update his own lexicon. METAL is integrated into a chain of automated processes from the acquisition of the source text to the production of a camera-ready version of the target text. User experiences show a marked productivity gain and a reduction of turn-around time. Author

N91-13360# Centre de Documentation de l'Armement, Paris (France).

SYNTHESIS OF SOLUTIONS PROPOSED FOR END-USERS [SYNTHESE DES SOLUTIONS PROPOSEES AUX UTI!LISATEURS]

Albert Yanez *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 11 p In FRENCH (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Potential end-users of computer assisted translation (CAT), i.e., all in the profession, in order to reach and use the solution which adapts best to a particular case, must reduce the linguistic obstacles when meeting the level of communication beyond the proper language ghetto. In this synthesis, a list is found of solutions of some of the possible resources which go to a term bank dictionary until the logic of lexicographical management or of analysis of text or aid in translation, certain that in most cases agreement will be found. The results are usable, but if disappointing, assistance can be sought from a translator or human examiner. Meanwhile, the perfect system of the future, which has been researched for many years, does not exist because the bridge between the conceptualist and end-user has not been crossed. From their cooperation would come the solution. If solutions are not offered, they must be built. This is why products (tools and systems) available on the market, and CAT especially, emphasis must be placed on the socio-politico-economic aspects, if there are to be genuine solutions, i.e., a time when the introduction of these tools and CAT become factors of productivity, opportunity, and progress. Now some end-users have begun to use the method, in which others can also be involved, alone or unison.

Transl. by E.R.

N91-13361# Aerospatiale, Suresnes (France). Centre d'Information Documentaire Commun.

COMPARISON BETWEEN HUMAN AND AUTOMATIC TRANSLATIONS (QUALITY, COSTS, AND PROCESSING TIME)

Oleg Lavroff *In* AGARD, Benefits of Computer Assisted Translation to Information Managers and End-Users Jun. 1990 6 p (For primary document see N91-13352 04-82)

Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Rough machine translations or automatically translated texts and post-edited texts (resulting from a refined post edition) is presented together with the respective time a translator devotes to translation when using the SYSTRAN system. The times and costs of automatic translation are summarized, which thus highlights the increased productivity of CAT compared to an all-human translation. The results mentioned hereafter only apply to translations for which the company's liability is not involved.

Author

N91-13362*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.

THE JOHNSON SPACE CENTER MANAGEMENT INFORMATION SYSTEMS (JSCMIS): AN INTERFACE FOR ORGANIZATIONAL DATABASES

Peter C. Bishop and Lloyd Erickson (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.) Feb. 1990 54 p

(Contract NCC9-16)

(NASA-CR-187256; NAS 1.26:187256) Avail: NTIS HC/MF A04 CSCL 05B

The Management Information and Decision Support Environment (MIDSE) is a research activity to build and test a prototype of a generic human interface on the Johnson Space Center (JSC) Information Network (CIN). The existing interfaces were developed specifically to support operations rather than the type of data which management could use. The diversity of the many interfaces and their relative difficulty discouraged occasional users from attempting to use them for their purposes. The MIDSE activity approached this problem by designing and building an interface to one JSC data base - the personnel statistics tables of the NASA Personnel and Payroll System (NPPS). The interface was designed against the following requirements: generic (use with any relational NOMAD data base); easy to learn (intuitive operations for new users); easy to use (efficient operations for experienced users); self-documenting (help facility which informs users about the data base structure as well as the operation of the interface); and low maintenance (easy configuration to new applications). A prototype interface entitled the JSC Management Information Systems (JSCMIS) was produced. It resides on CIN/PROFS and is available to JSC management who request it. The interface has passed management review and is ready for early use. Three kinds of data are now available: personnel statistics, personnel register, and plan/actual cost. Author

N91-13363*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
FACTORS SHAPING THE EVOLUTION OF ELECTRONIC DOCUMENTATION SYSTEMS
Christopher J. Dede, Tim R. Sullivan, and Jacque R. Scace 1990 128 p
(Contract NCC9-16)
(NASA-CR-187257; NAS 1.26:187257) Avail: NTIS HC/MF A07 CSCL 05B

The main goal is to prepare the space station technical and managerial structure for likely changes in the creation, capture, transfer, and utilization of knowledge. By anticipating advances, the design of Space Station Project (SSP) information systems can be tailored to facilitate a progression of increasingly sophisticated strategies as the space station evolves. Future generations of advanced information systems will use increases in power to deliver environmentally meaningful, contextually targeted, interconnected data (knowledge). The concept of a Knowledge Base Management System is emerging when the problem is focused on how information systems can perform such a conversion of raw data. Such a system would include traditional management functions for large space databases. Added artificial intelligence features might encompass co-existing knowledge representation schemes; effective control structures for deductive, plausible, and inductive reasoning; means for knowledge acquisition, refinement, and validation; explanation facilities; and dynamic human intervention. The major areas covered include: alternative knowledge representation approaches; advanced user interface capabilities; computer-supported cooperative work; the evolution of information system hardware; standardization, compatibility, and connectivity; and organizational impacts of information intensive environments. Author

N91-13364*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE JOHNSON SPACE CENTER MANAGEMENT INFORMATION SYSTEMS: USER'S GUIDE TO JSCMIS
Peter C. Bishop (Houston Univ., Clear Lake, TX.) and Lloyd Erickson Feb. 1990 149 p
(Contract NCC9-16)
(NASA-CR-187258; NAS 1.26:187258) Avail: NTIS HC/MF A07 CSCL 05B

The Johnson Space Center Management Information System (JSCMIS) is an interface to computer data bases at the NASA Johnson Space Center which allows an authorized user to browse and retrieve information from a variety of sources with minimum effort. The User's Guide to JSCMIS is the supplement to the JSCMIS Research Report which details the objectives, the architecture, and implementation of the interface. It is a tutorial on how to use the interface and a reference for details about it. The guide is structured like an extended JSCMIS session, describing all of the interface features and how to use them. It also contains an appendix with each of the standard FORMATs currently included in the interface. Users may review them to decide which FORMAT most suits their needs. Author

N91-13365# Federal Aviation Administration, Washington, DC. Office of Public Affairs.
GUIDE TO FEDERAL AVIATION ADMINISTRATION PUBLICATIONS, 12TH EDITION
May 1990 72 p
(PB90-247297; FAA-APA-PG-12) Avail: NTIS HC/MF A04 CSCL 05B

The twelfth edition of the Guide to Federal Aviation Administration Publications can help identify and obtain FAA publications, as well as aviation-related publications issued by other Federal agencies. GRA

N91-13366# Commerce Dept., Washington, DC. Office of the Secretary.
REPORT TO THE CONGRESS FROM THE SECRETARY OF COMMERCE ON THE NATIONAL TECHNICAL INFORMATION SERVICE Annual Report, FY 1989
1989 62 p
(PB90-238569) Avail: NTIS HC/MF A04 CSCL 05B

Legislation passed in 1988 authorized the National Technical Information Service (NTIS) to 'modernize' its operations, make use of cooperative agreements with the private sector, and provided for stronger representation in technology issues both in the United States and abroad. The 1989 Annual Report details NTIS progress. The major areas covered include: modernization; increasing and expanding the collection; foreign technology; audit results; the private sector; and technology transfer. Y.S.

N91-13367# Naval Postgraduate School, Monterey, CA.
THE INSTRUMENTATION OF A PARALLEL AND SCALABLE DATABASE COMPUTER: THE MULTI-BACKEND DATABASE COMPUTER, FOR BENCHMARKING ITS COMPLEX OPERATIONS M.S. Thesis
Darrell W. Alston Dec. 1989 82 p
(AD-A225385) Avail: NTIS HC/MF A05 CSCL 12/5

This study is the continuation of a performance evaluation technique known as benchmarking to an experimental database management system known as the Multi-Backend Database System (MBDS). The main emphasis of this thesis is on the instrumentation of this parallel and scalable database computer, for benchmarking its complex operations: update and retrieve-common. The primary research question is to determine whether MBDS demonstrates the response-time reduction and response-time invariance claims when carrying out its two complex operations. In order to benchmark these transactions, the proper instrumentation of the test database, test transaction sets, and test procedures were thoroughly executed. GRA

N91-13368# Office of Naval Research European Office, FPO New York, NY.
PROCEEDINGS OF THE U.K. INFORMATION TECHNOLOGY CONFERENCE
J. F. Blackburn 29 Jun. 1990 21 p Conference held in Hampton, VA, 19-22 Mar. 1990
(AD-A225509; ONREUR-90-4-C) Avail: NTIS HC/MF A03 CSCL 05/2

The U.K. Information Technology (IT) 1990 Conference took place at the University of Southampton, March 19 to 22, 1990. The conference was organized by the Computing and Control Division, Institution of Electrical Engineers, along with the British Computer Society, the Department of Trade and Industry, and the Science and Engineering Research Council. To some degree, it replaces the Alvey Conferences held annually between 1983 and 1988. The main topics covered in this conference were each supported by several technical papers. The main topics covered were: The Cycle of Software Engineering; Knowledge, Acquisition, and Development Methodology; Security and Fault Tolerance; Systems, Concurrency, Real Time; Vision; Control Systems and Environments; Formal Modeling Methods: System, Quality, Metrics; Parallel and Distributed Architecture; VLSI; Experimental Systems; Formal Aspects; System Design; Tools; Instrumentation and Intelligence; KBS; Speech Applications; Object Oriented Systems: KBS with Other Technologies; and Speech Language and Vision. GRA

N91-13369# Naval Oceanographic Office, Bay Saint Louis, MS.
COMPACTION OF GLOBAL DATA FIELDS Final Report
A. H. VanTuyl May 1990 27 p
(AD-A225856; NOARL-TN-27) Avail: NTIS HC/MF A03 CSCL 12/5

Two methods of compacting global data fields are studied, both individually and in combination, and errors associated with the methods are systematically examined. The first scheme consists of expanding the data into an empirical orthogonal function (EOF) series in the vertical, then truncating the series at a selected number of terms. Because the EOFs are ordered by decreasing variance explained, this reduces the number of degrees of freedom while retaining most of the important vertical structure information. The second technique used is bit reduction, in which appropriately

scaled data (here, spectral coefficients) are converted to integer form, with the scaling factor chosen so that the maximum data value is the largest integer expressible by some desired number of bits. Examination of compaction errors for various EOF truncations and bit scalings indicates that one important result of bit reduction is to set to zero all coefficients with magnitude below a certain threshold, causing EOF truncation up to a given point to have no impact on errors. Based on a somewhat arbitrarily selected maximum allowable RMS temperature error of 1 deg C, a compaction factor of approximately two is obtainable from EOF truncation alone, and an additional factor of three from bit reduction (32 bits to 10), assuming half precision words. Future work is needed, however, to determine the generality of these results.
Author (GRA)

N91-13370# Defense Technical Information Center, Alexandria, VA.
DEFENSE TECHNICAL INFORMATION CENTER THESAURUS
Charles R. Jacobs Sep. 1990 243 p
(AD-A226000; DTICH-4185.7) Avail: NTIS HC/MF A11 CSCL 05/2

This DTIC Thesaurus provides a basic multidisciplinary subject term vocabulary used by DTIC to index and retrieve scientific and technical information from its various databases and to aid DTIC's users in their information storage and retrieval operations. It includes an alphabetical Posting term display, a hierarchy display and a keyword-out-of-context (KWOC) display. GRA

N91-13371# Naval Postgraduate School, Monterey, CA.
ECONOMIC DEVELOPMENT OF SMALL-SCALE INFORMATION SYSTEMS M.S. Thesis
John L. Ash, Jr. and Dale R. Spaulding Mar. 1990 98 p
(AD-A226162) Avail: NTIS HC/MF A05 CSCL 12/7

In virtually any organization, (military or civilian, large or small), there are a number of unsolved small-scale information system problems. They will remain unsolved until we (system analysts and designers) develop a methodology that allows generation of timely and cost-effective automated solutions. The requisite resources exist; they have yet to be combined in the right order for success. It is the primary goal of this research to purpose, justify, and demonstrate (through a detailed case study) a simple-to-employ methodology for quick and cost-effective development of small-scale information systems (SSIS) without professional analysts, designers, or programmers. GRA

N91-13372# Naval Postgraduate School, Monterey, CA.
MANAGEMENT CONCERNS FOR OPTICAL BASED FILING SYSTEMS M.S. Thesis
Joseph F. Rodriguez Mar. 1990 76 p
(AD-A226400) Avail: NTIS HC/MF A05 CSCL 09/5

The use of optical technology has been assessed as the next step in the storage of information. Optical imaging systems for paper management have the potential benefits of improving productivity and permitting access to information on paper quickly. Although optical media is a relatively new technology there are many articles addressing the uses for optical media. With the exception of compact disks, optical disks have not gained rapid acceptance even though the market potential due to the storage capabilities of optical disks is much greater than standard magnetic media. One aspect about optical systems that does not receive much attention is how organizations should introduce optical media filing systems in their organizations. Speed, compatibility with current systems, paper administration, legal issues, and strategic planning are just a few of the issues that have to be addressed. This thesis investigated management concerns which must be addressed when considering document imaging systems. GRA

N91-13373# Energy Technology Data Exchange, Oak Ridge, TN.
INTERNATIONAL ENERGY SUBJECT CATEGORIES AND SCOPE
M. C. Grissom, ed. and L. Kane, ed. 1990 59 p
(DE90-015197; ETDE/PUB-1-R1) Avail: NTIS HC/MF A04

The purpose of this population is twofold: (1) to support organizations or individuals who select informational materials for inclusions in the ETDE (Energy Technology Data Exchange); and (2) for use as an aid in database searching. Subject categories and corresponding codes are established to define the scope of, or degree of interest in, energy information to be selected by those who enter machine-readable bibliographic records into the Energy Data Base. For persons conducting online searching or creating selective dissemination of information (SDI) subsets, this publication facilitates the selection of energy topics. These scope notes and category definitions also apply to online energy databases identified as ENERGY on STN International (Federal Republic of Germany) and as DOE ENERGY offered by Dialog Information Services (USA). This publication is the first revision and contains no changes from International Energy: Subject Categories and Scope (ETDE/PUB-1) with the exception that title page and contents pages have been added. DOE

N91-13374*# National Aeronautics and Space Administration, Washington, DC.
NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS: A CATALOG OF SPECIAL PUBLICATIONS, REFERENCE PUBLICATIONS, CONFERENCE PUBLICATIONS, AND TECHNICAL PAPERS, 1989
Feb. 1990 61 p
(NASA-SP-7063(04); NAS 1.21:7063(04)) Avail: NTIS HC free as PR-869; NASA Scientific and Technical Information Facility, BWI Airport, MD free CSCL 05B

This catalog lists 190 citations of all NASA Special Publications, NASA Reference Publications, NASA Conference Publications, and NASA Technical Papers that were entered into the NASA scientific and technical information database during accession year 1989. The entries are grouped by subject category. Indexes of subject terms, personal authors, and NASA report numbers are provided.
Author

N91-13375# Naval Postgraduate School, Monterey, CA. Dept. of Administrative Sciences.
THE ESTABLISHMENT OF A MANAGEMENT INFORMATION SYSTEMS RESEARCH CENTER AT THE NAVAL POSTGRADUATE SCHOOL M.S. Thesis
John F. Feiler Sep. 1989 188 p
(AD-A226517) Avail: NTIS HC/MF A09 CSCL 12/7

This thesis investigates the opportunity for the establishment of a Management Information Systems research center at the Naval Postgraduate School and the unique purpose it would serve within the Department of Defense community. Following the analysis of five existing information systems research centers and their various objectives and activities, pertinent issues regarding the Naval Postgraduate School are identified through interviews of relevant faculty and staff. A mission is identified for a Naval Postgraduate School Information Systems Research Center, and a strategy involving the center's objectives and activities is suggested. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N91-13376# Committee on Commerce, Science, and Transportation (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, FISCAL YEAR 1991
Ernest F. Hollings Washington GPO 1990 53 p Report to accompany S. 2287 presented by the Committee on Commerce, Science, and Transportation, 101st Congress, 2d Session, 11 Sep. 1990
(S-Rept-101-455; GPO-39-010) Avail: Document Room, Senate, Washington, DC 20510 HC free

The Senate committee on Commerce, Science, and Transportation presents the NASA Authorization Act for fiscal 1991. This act authorizes appropriations to NASA for research and development, space flight, control and data communications, construction of facilities, research and programs management, and many aspects of the Space Transportation System. M.G.

N91-13377# Committee on Science, Space and Technology (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION MULTIYEAR AUTHORIZATION ACT OF 1990
Robert A. Roe Washington GPO 26 Sep. 1990 82 p Report to accompany H.R. 5649 presented by the Committee on Science, Space, and Technology, 101st Congress, 2d Session, 26 Sep. 1990
(H-Rept-101-763; GPO-39-006) Avail: Document Room, House of Representatives, Washington, DC 20515 HC free

The House of Representatives' Committee on Science, Space, and Technology presents the NASA Multiyear Authorization Act of 1990. The act authorizes appropriations for research and development, space flight, control and data communications, construction of facilities, research and program management, and many aspects of the Space Transportation System. M.G.

N91-12586# Messerschmitt-Boelkow-Blohm G.m.b.H., Brussels (Belgium).
INTERNATIONAL COOPERATION IN AERONAUTICAL RESEARCH AND DEVELOPMENT CARRIED OUT BY INTERNATIONAL ORGANISATIONS
Juergen H. Wild *In* AGARD, Seminar on the Structure of Aeronautical R/D May 1990 27 p (For primary document see N91-12579 04-01)
Copyright Avail: NTIS HC/MF A06; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

No abstracts in this category.

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N91-13378*# Ohio State Univ., Columbus. Dept. of Astronomy.
ULTRAVIOLET SPECTROSCOPY OF PLANETARY NEBULAE: COSMOLOGICAL IMPLICATIONS Semiannual Report
Gary J. Ferland Oct. 1990 55 p
(Grant NAG5-1027; RF Proj. 766473/720304)
(NASA-CR-187237; NAS 1.26:187237) Avail: NTIS HC/MF A04 CSCL 03A

Optical spectrophotometry of PW Vulpeculae (Nova Vul 1984 no. 1) is combined with ultraviolet data to estimate electron temperatures, densities, and abundances in the ejecta of this slow classical nova. The reddening, distance, and evolution of the ultraviolet spectrum are also discussed. Abundances are nearly solar, with the exception of Nitrogen, which is substantially higher. Although Neon has been reported to be enhanced in several novae, it does not seem to be the case for PW Vul. Photoionization model calculations are presented of the ejecta that give a reasonable match of the observed emission spectrum. A strong featureless continuum shows that very hot, presumably shock heated, gas plays a major role in determining the energetics of this nova. Emission from this hot gas is responsible for the ionization of the nebular gas. A calculation of the masses of both the hot coronal gas and the cooler nebular gas shows that the former may account for most of the mass of the ejecta. Author

N91-13379 Dartmouth Coll., Hanover, NH.
ATMOSPHERIC STUDIES OF C2 WHITE DWARFS Ph.D. Thesis
Steven Roger Swanson 1989 92 p
Avail: Univ. Microfilms Order No. DA9024887

Model atmosphere and line formation calculations for the delta nu = + 1 Swan bands of the C2 molecule are presented for seven white dwarfs and are compared to high resolution optical spectra. Limits on the C-12 to C-13 ratio are computed for highly pressure broadened lines and are used to analyze the observed spectra for any sign of absorption by the (C-12)(C-13) molecule. The metal abundances in cool white dwarf atmospheres and the usefulness of the determination of the C-12 to C-13 ratio are discussed. The line center shift and the pressure broadening are used to determine a value for the van der Waals interaction constant, C6. This is done using a detailed line modelling program which explicitly includes approximately 2000 rotational transition lines within the vibrational bands, in conjunction with atmospheric models calculated by the LUCIFER atmosphere modelling program. The isotopic shift of the vibrational and rotational lines is also included in the model to compare the detectability of various C-12 to C-13 ratios. The line models fit the observed spectra with varying degrees of accuracy. One star, WD0548-001, shows an unusually small pressure shift and broadening for the high pressures that the atmospheric model predicts. The results show that only in the hottest stars with the least pressure broadened lines in this study can the isotopic effect be seen. With the data available, the best limit on the C-12 to C-13 ratio is a minimum of 40 for WD0856 + 331. The models show that even for very high signal to noise data, the isotopic shift in the Swan bands in very cool white dwarfs would be difficult to separate from the pressure broadening effects. It is shown that the isotopic ratio is high enough to rule out the possibility that the carbon is a relic from previous CNO burning. Dissert. Abstr.

N91-13380 California Univ., Berkeley.
A REDSHIFT SURVEY OF IRAS GALAXIES Ph.D. Thesis
Michael Abram Strauss 1989 298 p
Avail: Univ. Microfilms Order No. DA9029038

The results of a full-sky flux-limited redshift survey of galaxies detected by the Infrared Astronomical Satellite (IRAS) are presented. Care is taken to correct the infrared flux densities for a variety of systematic biases of the IRAS database. The sample consists of 2636 galaxies covering 87.6 percent of the sky, and has a characteristic depth of 3500 km/s, or 35 Mpc for H(sub o) = 100 Km/S Mpc(exp -1). We use linear perturbation theory to relate the dipole moment of the galaxy distribution to the peculiar velocity of the Local Group; the angle between the two vectors is only 19 degrees. A comparison of the amplitudes of these two vectors yields an estimate of the cosmological density parameter omega = 0.70 plus or minus 0.16. The assumptions that enter into this calculation are critically examined, and the possibility of systematic errors is emphasized. The relation between the dipole moment of the galaxy distribution, and the peculiar velocities of galaxies, allows us to predict the peculiar velocity field at every point within the volume enclosed by the sample; redshifts are corrected self-consistently for peculiar velocities using a robust iteration procedure. The velocity field shows strong infall into two major centers of mass concentration: the Pisces-Perseus supercluster and the Hydra-Centaurus supercluster. We make detailed comparisons of these predictions with directly observed peculiar velocities of galaxies from a variety of sources. There are systematic differences between observed and predicted peculiar velocities in various regions of the sky. In particular, the observations show a larger amplitude of infall towards the Hydra-Centaurus region than is predicted by the IRAS density distribution. This may indicate that the assumption that our sample traces the density distribution of dark matter is not correct in detail. Dissert. Abstr.

N91-13381*# Wyoming Univ., Laramie. Infrared Observatory.
IMAGE CONSTRUCTION FROM THE IRAS SURVEY AND DATA FUSION
Tj. R. Bontekoe 21 Aug. 1990 8 p Presented at the Workshop on Restoration of HST Images and Spectra, Baltimore, MD, 21-22 Aug. 1990
(Grant NAG5-1246)
(NASA-CR-187640; NAS 1.26:187640) Avail: NTIS HC/MF A02 CSCL 03A

The IRAS survey data can be used successfully to produce images of extended objects. The major difficulty, viz. non-uniform sampling, different response functions for each detector, and varying signal-to-noise levels for each detector for each scan, were resolved. The results of three different image construction techniques are compared: co-addition, constrained least squares, and maximum entropy. The maximum entropy result is superior. An image of the galaxy M51 with an average spatial resolution of 45 arc seconds, is presented using 60 micron survey data. This exceeds the telescope diffraction limit of 1 minute of arc, at this wavelength. Data fusion is a proposed method for combining data from different instruments, with different spatial resolutions, at different wavelengths. Direct estimates of the physical parameters, temperature, density and composition, can be made from the data without prior images (re-)construction. An increase in the accuracy of these parameters is expected as the result of this more systematic approach. Author

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N91-13382*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
CREATION OF FULLY VECTORIZED FORTRAN CODE FOR INTEGRATING THE MOVEMENT OF DUST GRAINS IN INTERPLANETARY ENVIRONMENTS
Walter Colquitt (Houston Research, Inc., TX.) Jul. 1989 10 p (Contract NCC9-16)
(NASA-CR-187263; NAS 1.26:187263) Avail: NTIS HC/MF A02 CSCL 03B

The main objective is to improve the performance of a specific FORTRAN computer code from the Planetary Sciences Division of NASA/Johnson Space Center when used on a modern vectorizing supercomputer. The code is used to calculate orbits of dust grains that separate from comets and asteroids. This code accounts for influences of the sun and 8 planets (neglecting Pluto), solar wind, and solar light pressure including Poynting-Robertson drag. Calculations allow one to study the motion of these particles as they are influenced by the Earth or one of the other planets. Some of these particles become trapped just beyond the Earth for long periods of time. These integer period resonances vary from 3 orbits of the Earth and 2 orbits of the particles to as high as 14 to 13. Author

N91-13383*# McDonald Observatory, Austin, TX.
ASTROMETRY WITH THE ATF Semiannual Progress Report, 1 Feb. - 31 Jul. 1990
William H. Jefferys 31 Jul. 1990 12 p
(Grant NAG2-545)
(NASA-CR-187293; NAS 1.26:187293) Avail: NTIS HC/MF A03 CSCL 03B

A detailed study of the effects of gravitational radiation on the relative positions of objects was carried out with the hope that astrometric detection of gravitational radiation might be possible. The results are discouraging. It would appear that narrow-field instruments in the Astrometric Telescope Facility (ATF) class are still several orders of magnitude less accurate than would be required for this very delicate kind of measurement. However, the situation changes considerably when wide-field instruments are considered. An instrument such as POINTS ought to be able to detect gravitational radiation at this level with ease. The list of bright quasars has been augmented. Of particular interest is the finding of quasars near two open clusters and one planetary nebula. These would be useful in determining absolute parallaxes of these objects. Author

N91-13384 Illinois Univ., Urbana-Champaign.
A THEORETICAL STUDY OF PROBLEMS IN CLASSICAL NOVA EVOLUTION Ph.D. Thesis
Anurag Shankar 1990 176 p
Avail: Univ. Microfilms Order No. DA9026319

Three distinct issues in classical nova evolution are addressed with the aid of one- and two-dimensional numerical hydrodynamics. The effects of convection on nova outbursts are examined within the confines of the mixing length theory. It is found that increasing the efficiency of convection enhances the violence of the thermonuclear runaway (TNR). This also relates to the question of the feasibility of obtaining nova outbursts on magnetic white dwarfs among the AM Her systems. The effects of a strong magnetic field on the TNR are explored. The field interferes with the development of convection during the TNR, which results in lower ejection velocities. However, for field strengths typical of cataclysmic variables, the violence of strong outbursts is affected only moderately. The conditions necessary for the production of strong TNR's in the hibernation model of cataclysmic binary evolution are also examined. The feasibility of obtaining strong nova outbursts is investigated when the accretion rate during hibernation is decreased. It is found that a reduction (by a factor of 100) for periods of longer than a couple thousand years, is

sufficient to ensure violent outbursts, even in the presence of large pre-outburst accretion rates. The effects of a common envelope phase (CEP) on the outburst are discussed. The motion of the secondary through an expanding common envelope is resisted by frictional drag. This dissipates both energy and angular momentum from the orbit inducing hydrodynamic motion. Significant departures are found to occur in the manner in which mass is lost when the effects of drag are taken into account. Specifically, a CEP is found to accelerate and enhance mass loss. Ejection is found to be concentrated in the orbital plane, with velocities of a few thousand km/sec. Dissert. Abstr.

N91-13385 Oxford Univ. (England).
THE OUTER ATMOSPHERES OF HYBRID GIANTS Ph.D. Thesis
Graham M. Harper 1988 243 p
Avail: Univ. Microfilms Order No. BRD-89413

The physical nature of the outer atmospheres of the hybrid bright giants is explored. These stars show C IV emission and evidence of cool, fast winds--unlike giants of similar effective temperature, which possess only cool chromospheres. The K3 II star iota Aur is studied in detail. Chapter one discusses the importance of these stars in the context of the H-R diagram. Chapter two examines the evolutionary status of the hybrid bright giants and sets out the physical parameters which are adopted in the atmospheric modeling. In Chapter three, the high and low resolution international ultraviolet explorer (IUE) data extracted for iota Aur are discussed. In Chapter four, the emission line fluxes and profiles are analyzed and an emission measure distribution is calculated. Simple hydrostatic models of the transition region and corona are constructed. Chapter five describes the methodology employed to construct model chromospheres using non-LTE radiative transfer. In Chapter six, computations of the chromospheric structure of a hybrid star are presented for the first time. Calculations made for the first time show that the excitation of the Fe 1 y(sup 5) G 0/3 level by the Mg II k line can produce the observed emission in other transitions from the J = three level. In Chapter seven, non-isothermal Alfven wave driven wind models are calculated. It is shown that iota Aur proves to be a severe test of these models and that the transition region and the cool wind are physically separate. Dissert. Abstr.

N91-13386 Purdue Univ., West Lafayette, IN.
TEST AND APPLICATION OF GRAVITATIONAL THEORIES IN ASTRONOMICAL SYSTEMS Ph.D. Thesis
Ziye Zhou 1989 109 p
Avail: Univ. Microfilms Order No. DA9018939

Constraints are made on a variety of Newtonian perturbations that could conspire to imitate the timing effects of the relativistic two-body model. This will provide an assessment on the quality of the evidence that the decay of the pulsar's orbital period is caused by the energy loss of the binary pulsar system in the form of gravitational radiation. A timing model for the binary pulsar system PSR 1913+16 which includes both relativistic timing effects and the effects of conceivable rotational and tidal distortions of the pulsar's companion star was developed. The deformation of the companion star would modify its Newtonian gravitational field which affects the orbit of the pulsar. The periodic perturbations that occur at harmonics of the pulsar's orbital period were calculated. These characteristic periodic effects can generally indicate distinctively the presence of rotational and tidal distortions of the pulsar's companion star. The analysis shows that the timing effect of the gravitational red shift and second order Doppler shift and the effect of the Shapiro propagation delay of the pulse can be isolated from all these effects. They can be used to obtain a reliable estimate of the masses of the pulsar and its companion star whatever the nature of the companion. This new constraint can rule out any possibility that the pulsar's companion is a helium star and it sharply constrains the rotational distortion of a conceivable white dwarf companion. The deflection of star light by the gravitational field of the sun is also examined. The gravitational field generated by currents of matter within a body influences the deflection of light by the body. In metric theories of gravity the Einstein equivalence principle is shown to imply a deeper connection than had been realized between this deflection and the Lense-Thirring dragging of inertial frames. Dissert. Abstr.

N91-13387# Washington Univ., Seattle. Nuclear Theory Group.
SUPERNOVA NEUTRINOS, GIANT RESONANCES, AND NUCLEOSYNTHESIS
Wick Haxton 1990 10 p Presented at the Symposium in Honor of Akito Arima: Nuclear Physics in the 1990's, Santa Fe, NM, 1-5 May 1990
(Contract DE-FG06-88ER-40427)
(DE91-001148; DOE/ER-40427/13-N90; CONF-9005238-3)
Avail: NTIS HC/MF A02

Almost all of the 3 x 10(exp 53) ergs liberated in a core collapse supernova is radiated as neutrinos by the cooling neutron star. The neutrinos can excite nuclei in the mantle of the star by their neutral and charged current reactions. It is argued that the resulting spallation reactions are an important nucleosynthesis mechanism that may be responsible for the galactic abundances of Li-7, B-11, F-19, La-138, Ta-180, and approximately a dozen other light nuclei. DOE

N91-13388# Ludwig-Maximilians-Univ., Munich (Germany, F.R.). Fakultaet fuer Physik.
ELECTRODYNAMIC ARROW OF TIME AND COSMOLOGY Ph.D. Thesis [ELEKTRODYNAMISCHER ZEITPFEIL UND KOSMOLOGIE]
Hans-Dieter Radecke 1988 125 p In GERMAN
(ETN-90-98188) Avail: NTIS HC/MF A06

Simplified mathematical models were used for the examination of the relationship between the arrows of time of electrodynamics and cosmology. The model of a 1-D harmonic oscillator, coupled to a scalar field, was first used. The combined system of coupled differential equations could be exactly resolved and allowed an examination of the field solution type, with regard to retard and advance in the framework of the cosmological geometry of the standard model, by which a closed universe was taken as a basis. It was shown that the oscillation radiation was clearly retarded at the big bang, and clearly advanced at the final explosion. In order to interpolate between these asymptotical boundary values, it was necessary to consider the radiation absorption of the cosmical medium. The general behavior of the considered system solutions showed that only the retarded radiation prevailed at big bang. Because of the cosmical absorption, its amplitude was completely attenuated to zero, before the universe heat death was installed. The advanced field amplitude is to be preceived after the universe contraction beginning and swings to a maximal value which is reached at the final explosion. ESA

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N91-13389# Consiglio Nazionale delle Ricerche, Frascati (Italy).
PLANETARY FOURIER SPECTROMETER OR RESEARCH ON MARTIAN ATMOSPHERE BY MEANS OF SPECTROSCOPIC KEY ABSORPTIONS (ROMA-MOSKA): A MICHELSON INTERFEROMETER FOR ATMOSPHERIC STUDIES ON BOARD MARS 94 MISSION
V. Formisano, E. Amata, G. Bellucci, G. Chionchio, P. Baldetti, A. Carusi, A. Coradini, P. Cerroni, M. T. Capria, and F. Capaccioni (Italian Space Agency, Rome.) et al Mar. 1990 199 p
(IFSI-90-7; ETN-90-97790) Avail: NTIS HC/MF A09

The Mars 94 mission and payload and orbit around Mars are discussed. Scientific objectives including the investigation of Martian atmosphere and spectroscopic and chemical and mineral composition of the Mars surface are outlined. The planetary Fourier spectrometer is described. The experimental scheme, optical banks, moving mirror, laser diode, sensors, radiative cooling,

pointing platform, data processing unit, fast Fourier transform unit, calibrations, ground support equipment and DC/DC convertor are described. Data handling and management and planning are discussed. ESA

N91-13390# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
VNIR-VIMS: A VISIBLE MAPPING SPECTROMETER FOR MARS-94
V. Formisano, G. Bellucci, G. Chionchio, E. Amata, A. Carusi, F. Capaccioni, A. Coradini, P. Cerrone, A. Adriani, and M. Viterbini (Istituto di Fisica dell Atmosfera, Rome, Italy) et al May 1990 90 p Prepared in cooperation with Osservatorio Astronomico, Padua, Italy; Padua Univ., Italy; Catania Astrophysical Observatory, Italy; and Istituto Universitario Navale, Naples, Italy
(IFSI-90-17; ETN-90-97799) Avail: NTIS HC/MF A05

Instrumentation designed to support remote sensing of planetary surfaces by an infrared multispectral imager is presented. OMEGA-VIMS (French proposed observatory for mineralogy, water, ice and activity - U.S. proposed Visual Infrared Mapping Spectrometer) is an infrared spectrometer selected for the Soviet mission Mars 94. The design was optimized for flexibility to the Cassini (Saturn, Titan) and CRAF (Comet Rendez-vous and Asteroid Flyby) missions. The visible channel design, its nominal performances, and their use along the orbit around Mars are discussed. The optical, mechanical and electronical designs and considerations on interfacing problems, and the performance (signal to noise ratio) foreseen at Mars are presented. ESA

N91-13391*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
RESIDUAL CIRCULATIONS CALCULATED FROM SATELLITE DATA: THEIR RELATIONS TO OBSERVED TEMPERATURE AND OZONE DISTRIBUTIONS
Marvin A. Geller, Eric R. Nash (Applied Research Corp., Landover, MD.), Mao Fou Wu, and Joan E. Rosenfield 1990 26 p
(Grant NAG5-1206)
(NASA-CR-187631; NAS 1.26:187631) Avail: NTIS HC/MF A03 CSCL 03B

Monthly mean residual circulations were calculated from eight years of satellite data. The diabatic circulation is usually found to give a good approximation to the residual circulation, but this is not always the case. In particular, an example is shown at 60 deg S and 30 mbar where the diabatic and residual circulations show very different annual variations. Correlations between the vertical component of the residual circulation and temperature and ozone were computed. The computations indicate that yearly variations of temperatures in the tropics are under radiative control, except during stratospheric warmings. Interannual variations in seasonal mean temperatures are shown to be under dynamical control everywhere. Correlations between seasonal means of the vertical component of the residual circulation and ozone mixing ratios are consistent with what would be expected from the ozone variations being due to differences in the ozone transport, although transport effects cannot easily be distinguished from photochemical effects above the altitude of the ozone mixing ratio peak. Finally, variations in total ozone are examined in comparison with residual circulation variations. A one to two month phase lag is seen in the annual variation in the total ozone at 60 deg N with respect to the maximum downward residual motions. This phase lag is greater at 60 deg N than at 60 deg S. There is evidence at 60 deg S of a greater downward trend in the mean zonal ozone maxima than there is in the minima. A decreasing trend in the maximum descending motion is seen to accompany the ozone trend at 60 deg S. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N91-13392# Aerospace Corp., El Segundo, CA. Space Sciences Lab.
A SUNSPOT MAXIMUM PREDICTION USING A NEURAL NETWORK
Harry C. Koons and David J. Gorney 1 Feb. 1990 17 p
(Contract F04701-88-C-0089)
(AD-A225866; TR-0090(5940-06)-1; SSD-TR-90-16) Avail: NTIS HC/MF A03 CSCL 03/2

Based on the rapid increase in the sunspot numbers for the current solar cycle, the current cycle (number 22) is expected to produce the largest number of major solar flares of any cycle in recent history. Since a number of different types of spacecraft anomalies are related maxima in the solar activity, it is important to predict both the amplitude of the solar cycle and the time at which the maximum is expected to occur. A novel approach was taken to making such a prediction. Neural Network Simulation Software from California Scientific Software was used to predict the maximum 13 month smoothed sunspot number for cycle 22 and the month in which this maximum will occur. The neural network predicts the maximum sunspot number for cycle 22 to be 194 + or - 26, to occur 42 months (March 1990) after the minimum. The uncertainty in the prediction is taken to be the standard deviation of the difference between the predicted sunspot maximum and the observed sunspot maximum for 15 test cases taken from previous cycles. The prediction is in line with the predictions by NASA, 195 + or - 40, to occur in February 1990, and by NOAA, Space Environment Laboratory, 203 + or - 30, to occur in March 1990. GRA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N91-13393 Maryland Univ., College Park.
CHAOS AND RANDOM PROCESSES IN THE X RAY VARIABILITY OF CYGNUS X-1 Ph.D. Thesis
James Charles Lochner 1989 154 p
Avail: Univ. Microfilms Order No. DA9021538

The temporal variability of the x ray emission of the black hole candidate Cygnus X-1 was examined in an attempt to better characterize the source of the aperiodic variability. The emission is generally believed to come from a turbulent accretion disk surrounding the black hole. Two analysis techniques were applied to low energy x ray light curves: a search for a low-dimensional chaotic attractor; and a new technique to further develop the standard shot noise model. The search for a low-dimensional attractor tests the hypothesis that deterministic chaotic dynamics underlie the accretion disk physics. Using a standard time delay embedding, the phase space trajectory was constructed from the light curve, and the correlation integral was used to determine the dimension of the resulting manifold. The difficulties encountered by this method were investigated with a finite number of data points and a noise level not usually encountered in other applications. The data were not found to indicate that a low-dimensional attractor underlies the variability. This implies that the turbulence in the disk is well developed, and that simple models cannot reliably reconstruct the temporal variability. Shot noise models have long been used as phenomenological, stochastic models for the variability of Cygnus X-1, relying on random pulses of emission, each having a fixed shape and duration. A distribution of shot lengths from 0.01 s to 6.0 s was introduced to reproduce the power density spectrum of the data. The shot profile and the fraction of the emission are found by fitting the phase portrait of

the data with trial shot models. Both sets of data are found to be consistent with shots having a symmetric exponential rise and decay, and with the shot amplitude as a power law function of the shot length. These results are interpreted in terms of a distribution of magnetic flares in the disk. Dissert. Abstr.

N91-13394 Johns Hopkins Univ., Baltimore, MD.
HIGH-REDSHIFT RADIO GALAXIES AND THE ROLE OF RADIO SOURCES IN GALAXY FORMATION Ph.D. Thesis
Kenneth Carter Chambers 1990 240 p
Avail: Univ. Microfilms Order No. DA9030175

Radio, optical, and infrared studies were made of a portion of a sample of ultra steep 4C radio sources. Most are at high redshift, including 4C40.36 at $z = 2.267$ and the most distant galaxy known, 4C41.17 at $z = 3.8$. Their optical/infrared continua were found to be generally aligned with their radio axes. Demonstration of this alignment effect in the near infrared, by means of an infrared image of 3C368, provides a powerful constraint on theories of the origin of the alignment. The first direct evidence that the extended optical and infrared continuum of high redshift radio galaxies is dominated by starlight is presented in the form of stellar absorption features discovered in combined spectra. The shape of the rest frame ultraviolet spectrum suggests that although the present star formation rate in these objects is high, it was systematically higher in the immediate past. A young model for the stellar populations in high redshift radio galaxies is discussed and suggests that some of these galaxies may be relatively young and that they are being observed near the time in which they formed the bulk of their stars. This model is attractive in its ability to account for the spectral energy distributions (SED's) , the optical and infrared alignments, and the low dispersion and continuity of the infrared Hubble diagram. Therefore the most plausible explanation for the alignment effect is that powerful radio sources were capable of stimulating vast amounts of star formation at early epochs. Investigations of the properties of radio cocoons indicates that weak radio sources may also trigger star formation during the formation of a galaxy. Given the ubiquity of active nuclei in galaxies, the upturn in the faint radio source counts, and the isotropic extragalactic non-thermal background, it is suggested that radio sources may have played a significant role in determining some of the characteristics of normal galaxies. Dissert. Abstr.

99 GENERAL

N91-13395# National Inst. of Standards and Technology, Gaithersburg, MD. Center for Electronics and Electrical Engineering.
CENTER FOR ELECTRONICS AND ELECTRICAL ENGINEERING: 1990 PROGRAM DESCRIPTION
R. M. Powell Apr. 1990 35 p
(PB90-207754; NISTIR-90/4281) Avail: NTIS HC/MF A03
CSCL 05D

Selected projects of measurement development that Center for Electronics and Electrical Engineering (CEEE) is addressing during fiscal year 1990 are described. The directions that these projects will take in the next few years are indicated. Selected accomplishments during fiscal year 1989 are also described. Because of the size of CEEE and the scope of its work, only a representative sampling of these projects and accomplishments can be described in the document of this length. New programs of measurement development are outlined that CEEE has defined for future years. Author

N91-13396# Office of Naval Research European Office, FPO New York, NY.
BRITE/EURAM: THIRD TECHNOLOGICAL DAYS FOR THE BASIC RESEARCH IN INDUSTRIAL TECHNOLOGIES IN EUROPE/EUROPEAN RESEARCH IN ADVANCED MATERIALS
J. F. Blackburn 29 Jun. 1990 13 p Conference held in Brussels, Belgium, 21-22 May 1990
(AD-A225522; ONREUR-90-5-C) Avail: NTIS HC/MF A03
CSCL 13/8

The Third Technological Days for the Basic Research in Industrial Technologies in Europe/European Research in Advanced Materials (BRITE/EURAM) Program was held in Brussels, Belgium, May 21-22, 1990. The BRITE portion of the program concentrates on integrating several enabling technologies and disciplines, such as mechanics, optics, acoustics, and fluid dynamics in design and manufacturing. The EURAM deals with the development of new industrial materials and improvements of the materials life cycle of production, transformation, and recovery. GRA

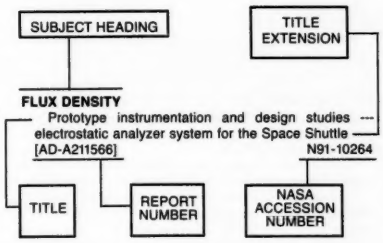
N91-13397# Lawrence Livermore National Lab., CA.
ENERGY AND TECHNOLOGY REVIEW, JULY-AUGUST, 1990
Alan K. Burnham, ed. 1990 114 p
(Contract W-7405-eng-48)
(DE91-000482; UCRL-52000-90-7-8) Avail: NTIS HC/MF A06

This report highlights various research programs conducted at the Lawrence Livermore National Lab which include: defense systems, laser research, fusion energy, biomedical and environmental sciences, engineering, physics, chemistry, materials science, and computational analysis. It also contains a statement on the state of the Lab and Laboratory Administration. DOE

N91-13398# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
SCIENTIFIC ACTIVITIES PROGRAM OF THE INSTITUTE OF PLANETARY SPACE PHYSICS FOR THE YEAR 1990 [PROGRAMMA DI ATTIVITA SCIENTIFICA ANNO 1990 IFSI]
Apr. 1990 89 p In ITALIAN
(IFSI-90-12; ETN-90-97795) Avail: NTIS HC/MF A05

The four main subjects of scientific activity are space plasma physics, infrared astronomy, gravitation, and cosmic rays. The experiments discussed include analysis of satellite data, development of a plasma camera, contributions for an infrared spectrometer for the Infrared Space Observatory (ISO) satellite, improvements on a gravitational antenna, neutron detection, and solar neutrons. ESA

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7064).

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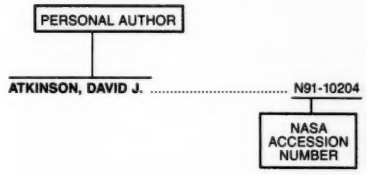

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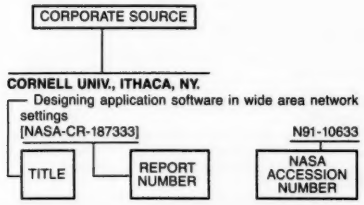

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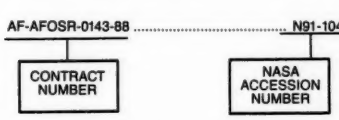

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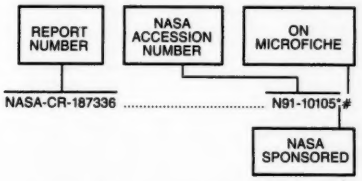

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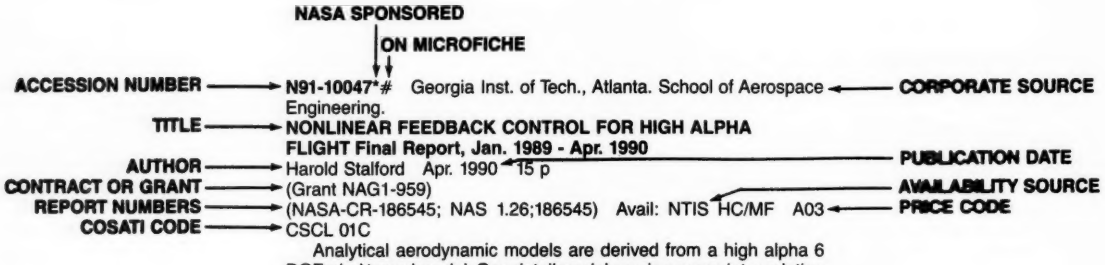
TYPICAL CITATION AND ABSTRACT



Analytical aerodynamic models are derived from a high alpha 6 DOF wind tunnel model. One detail model requires some interpolation between nonlinear functions of alpha. One analytical model requires no interpolation and as such is a completely continuous model. Flight path optimization is conducted on the basic maneuvers: half-loop, 90 degree pitch-up, and level turn. The optimal control analysis uses the derived analytical model in the equations of motion and is based on both moment and force equations. The maximum principle solution for the half-loop is poststall trajectory performing the half-loop in 13.6 seconds. The agility induced by thrust vectoring capability provided a minimum effect on reducing the maneuver time. By means of thrust vectoring control the 90 degrees pitch-up maneuver can be executed in a small place over a short time interval. The agility capability of thrust vectoring is quite beneficial for pitch-up maneuvers. The level turn results are based currently on only outer layer solutions of singular pertrubation. Poststall solutions provide high turn rates but generate higher losses of energy than that of classical sustained solutions.

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